WATER & SEWAGE WORKS

UNIVERSITY MICROFILMS
313 N. 1ST ST.
ANN ARBOR, MICH.
COMP

WATER SUPPLY • INDUSTRIAL WASTE TREATMENT • SEWAGE DISPOSAL

Table Rock - America's Reservoir Beautiful

MARCH 1955

on a Lock Joint "Foundation"

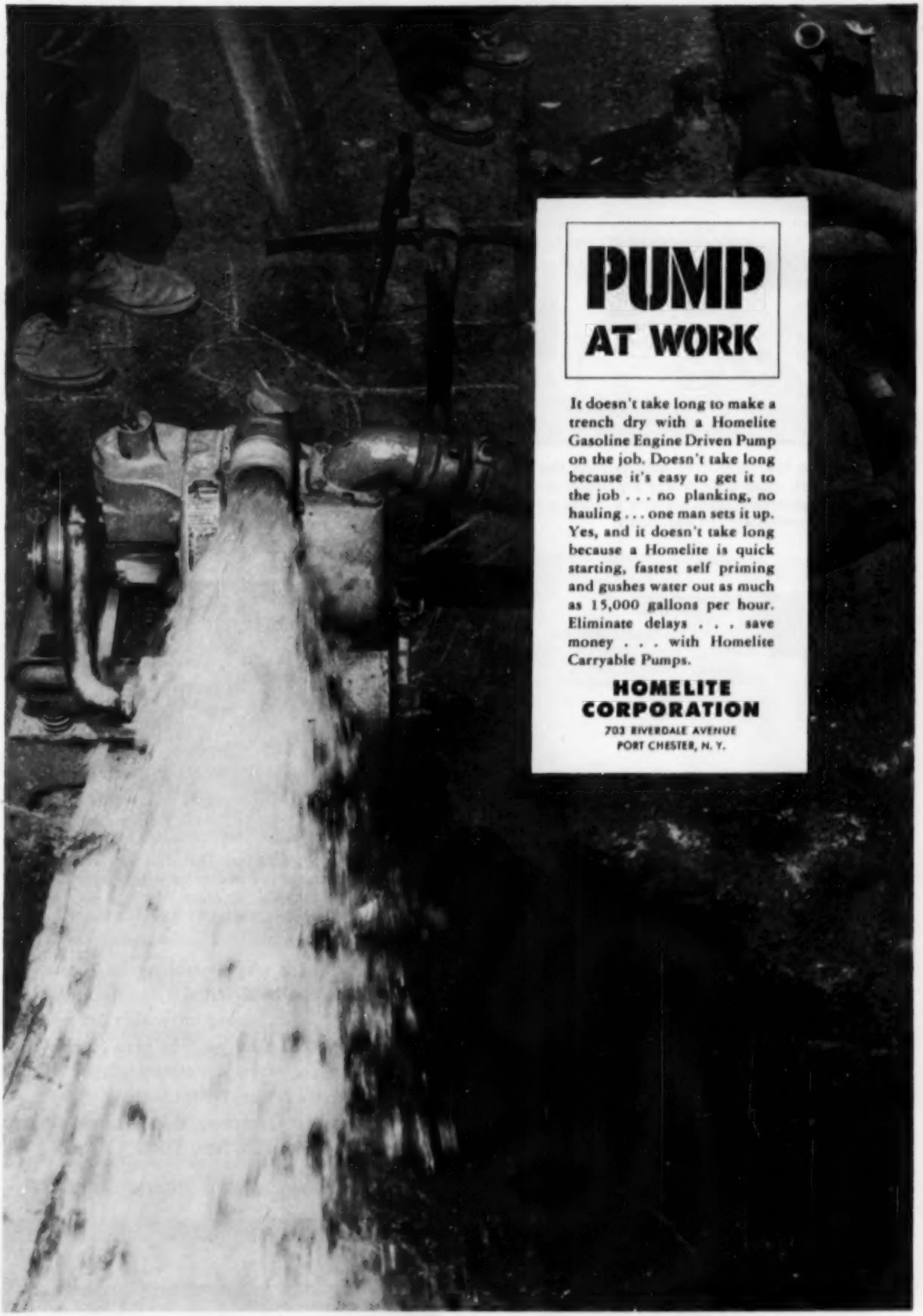
City planners and engineers are taking a long, hard look at everything connected with water supply — the most serious problem affecting the city's future growth. That's why so many cities, all over the world, have selected Lock Joint Pressure Pipe's greater security, more dependable performance, longer life. They know that their plans for meeting future water supply requirements must include pipes whose high carrying capacity will be as great scores of years from now as they are today.

In addition to a solid foundation for the water supply system of the future, Lock Joint Pressure Pipe offers important economies — low first cost, economical installation, low pumping costs and negligible maintenance charges.

LOCK JOINT PIPE COMPANY

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.



PUMP AT WORK

It doesn't take long to make a trench dry with a Homelite Gasoline Engine Driven Pump on the job. Doesn't take long because it's easy to get it to the job . . . no planking, no hauling . . . one man sets it up. Yes, and it doesn't take long because a Homelite is quick starting, fastest self priming and gushes water out as much as 15,000 gallons per hour. Eliminate delays . . . save money . . . with Homelite Carryable Pumps.

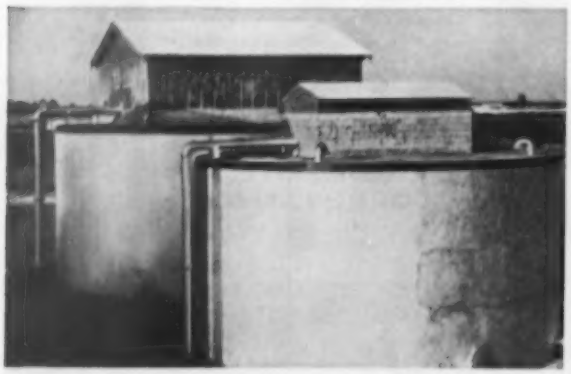
HOMELITE CORPORATION

703 RIVERDALE AVENUE
PORT CHESTER, N. Y.

HOLLYWOOD (*Florida*) SAVES $32,980 A YEAR

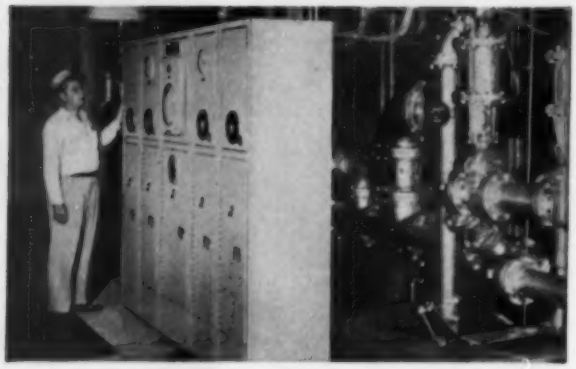
regenerating its softeners with sea water

1. Pumps draw sea water from wells beneath this station. Being inland, these wells deliver a partially filtered sea water. (Regenerating costs are now $25 less per million gallons than when dry salt was used.)



2. To prevent marine growths which would foul equipment, the sea water is aerated and chlorinated.

3. Sea water then passes through Permutit pressure filters (left) and is ready for regenerating the Permutit softeners (right). Sea water pumpage is kept to a minimum because high-capacity Permutit Q, used in the softeners, requires less salt for regeneration.



4. City Engineer George A. Gieseke inspects the Permutit control panel. It backwashes, regenerates and rinses the 4 newest softeners and places them on the line . . . *all without aid from the plant operator!* Two men per shift operate the entire water plant.

5. Hollywood is growing fast. Their first four Permutit softeners went on the line twenty years ago. Now there are 12 . . . and plant space for more. "We're in good shape," says City Engineer Gieseke.

It's easy to see why Consulting Engineers *Reynolds, Smith & Hills* chose Permutit equipment . . . for its long service life and low operating costs. And we'll be glad to help you make sure your water supply is "in good shape" for the future. Write to: Dept. W-2, The Permutit Company, 330 West 42nd Street, New York 36, New York.

WATER CONDITIONING HEADQUARTERS

PERMUTIT

WATER AND SEWAGE WORKS, Reg. U. S. Patent Off. Published monthly by Scranton Publishing Co., at 5th and Ferry St., Lafayette, Ind. Entered as second class matter at the post office at Lafayette, Ind., under Act of March 3, 1879. For subscription rates, see Contents Page.

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WATER SUPPLY • SEWAGE DISPOSAL
INDUSTRIAL WASTE TREATMENT

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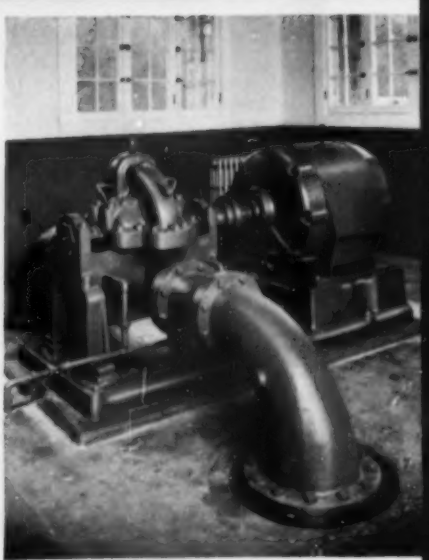
NEW BABSON PUMPING STATION
—one of three serving Gloucester, Mass. Consulting engineers: Metcalf & Eddy. Gen. contractor: Ralph P. Hall. Elec. contractor: Shepherd & Berts.

FACT: Reliable electrical link between utility and station is provided by a Westinghouse outdoor power center (4160/480 volts). Power is fed underground to control center in the station.

FACT: Centralized operation of the entire station is assured by this Westinghouse control center. Right cubicle was supplied empty to provide space for pressure gauges and flow meters.



FACT: This Westinghouse 200-hp, 1800-rpm, drip-proof motor drives main pump at a rate of 3400 gallons per minute. Installation also includes 75-hp auxiliary motor and pump.

FACT:

One 200-hp Westinghouse motor pumps 4,500,000 gallons a day

Operating simplicity is a keynote of Babson Pumping Station, erected recently at Gloucester, Massachusetts

FACT: This pumping station has been engineered so that a single pump, driven by a 200-hp Westinghouse Life-Line® motor, handles the entire station water supply—rated at 4,500,000 gallons a day.

FACT: Operating simplicity is further carried out with a Westinghouse control center. In a single enclosure, it groups controls for the main pump and stand-by motor, main controls for lighting circuits, and primary circuit controls that are interlocked with a Westinghouse outdoor power center.

For details on this case history and the Westinghouse team that helped coordinate it electrically . . . J-94027

Call *The Man With The Facts*, the construction sales engineer in your nearest Westinghouse office

YOU CAN BE SURE...IF IT'S

Westinghouse

Water

Seven Badger Meter Plants:

Milwaukee, Wisconsin

Brown Deer, Wisconsin

Badger

is vital... 1905

and for fifty years BADGER meters have conserved the nation's water BETTER

1955

Electric power

Irrigation

Industry

LIFE . . . health . . . electricity . . . food . . . industrial production—all these depend on the availability of water. For 50 years, since 1905, famous Badger meters have helped Americans conserve water better. They measure water precisely . . . help control water distribution and waste . . . make water departments more efficient and self-supporting. And service records prove the dependability of Badger meters . . . prove there are no finer water meters on the market. That's why they're the favorites . . . everywhere.

Fall River, Wisconsin

Milwaukee, Wisconsin (Research)

Los Angeles, California

Tulsa, Oklahoma

Medidoras Astecs, Mexico, D. F.

Water Meters

"Measuring the water of the world for 50 years"

Badger Meter Mfg. Co.
Milwaukee 45, Wis.

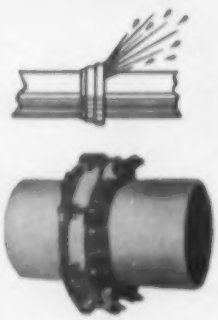
"YOU CAN FIX ANY LEAK OR BREAK..

making repairs the DRESSER way!"

HERE ARE A FEW OF DRESSER'S MANY

BELL-JOINT CLAMP
Style 60

To Repair Leaking Bell-and-Spigot Joints

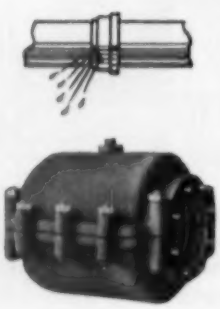


Dresser Bell-Joint Clamps provide the most effective means for stopping or preventing leaks in cast iron bell-and-spigot joints. The gaskets in Dresser Clamps are resilient, absorb pipe movement without leakage.

Wherever you've gone to the trouble and expense of uncovering a bell-and-spigot joint—*for any reason*—give it absolute protection against future failure with a Dresser Bell-Joint Clamp, Style 60!

BELL-PACK* SLEEVE
Style 126

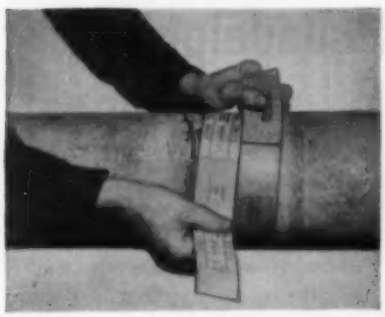
To Repair Split or Broken Bells



These Dresser Sleeves enclose split or broken bells, and breaks near the bell in cast iron bell-and-spigot joints. Lighter in weight than conventional sleeves, they have no loose parts, require no caulking or packing. You simply put the Bell-Pack Sleeve halves around the pipe and tighten.

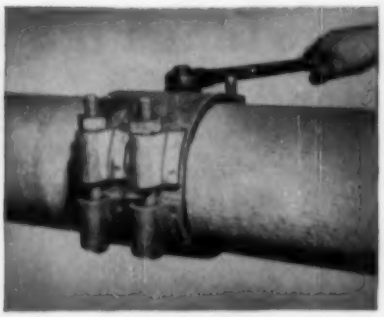
Keep Dresser Bell-Pack Sleeves *in stock* for fast, economical, permanent repairs.

DRESSER® REPAIR PRODUCTS



Simple: Measure with tape furnished.

Cut Gasket to proper length, wrap.



Install clamp, bolt up in minutes.

*Hydrepair** Clamp, Style 179

Proved, low-cost way to repair asbestos-cement and cast iron pipe

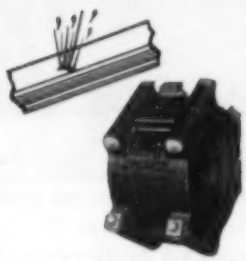
Here is a high-strength clamp that offers a wide range of fit, yet is lowest in cost.

Dresser's HYDREPAIR Clamp, Style 179, fits virtually all diameters within a nominal pipe size. This unique range of fit is achieved through a "wrap-around" gasket seal . . . *permits installation of the clamp on either rough barrel or machined ends of asbestos-cement pipe, and all classes of cast iron pipe.*

Doing triple duty, Dresser HYDREPAIR Clamps offer you triple savings . . . time, money and inventory.

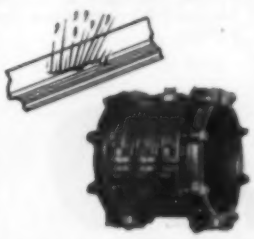
AND WIDELY-VARIED REPAIR PRODUCTS

ADJUSTABLE REPAIR SLEEVE—Style 82



Style 82 Repair Sleeves accommodate the many differing pipe diameters found in cast iron water mains . . . are low in cost. Each sleeve has a tapping outlet to simplify service taps. Two-inch taps can be made safely off four-inch main.

SPLIT REPAIR SLEEVE—Style 57c



Used as single or multiple units, Style 57c Repair Sleeves have long been favorites with maintenance supervisors who demand the highest quality sleeve for the repair of cast iron pipe. They are especially adaptable for longer breaks and diameter through 12 inches.

Your Repair Problems Helped Develop Our Repair Products

By telling us of everyday repair problems, you watermen have had a big hand in helping Dresser develop today's complete line of repair products.

Each of these products has been carefully designed to give you a permanent repair device for each problem . . . one which would make the job relatively quick and simple and, at the same time, most economical.

Your local waterworks supplier can give you full details and fast delivery on all Dresser repair products.* While you're talking to him, ask about the many other Dresser products which can make joining as well as repairing pipe easier, *surer!

*Trade-marks of Dresser Manufacturing Division

DRESSER MANUFACTURING DIVISION

(One of the Dresser Industries)

69 Fisher Ave., Bradford, Pa. • Warehouses in: Houston, Texas; San Francisco, California

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STEEL PIPE helps cut cost of Philadelphia's long-range program of waterworks improvement

The tracks you see in the first photo below are part of the Pennsylvania Railroad's main line. That's one reason why the pipes passing under the tracks are built of strong, *electric welded steel.*

Engineers know from experience that Alco Electric Welded Steel Pipe has the strength and resilience to absorb vibration, impact and overloading that destroy pipe of other types. They know, too, that Electric Welded Steel Pipe offers still other advantages that help cut piping costs. For example:

Efficiency—Smooth, tar-enameled inside surface gives excellent rate of flow. *Economy*—not only is first cost low but sections are long and light, for fast, easy installation. And *durability*—estimated life is 75 to 100 years.

Alco makes Electric Welded Steel Pipe to meet AWWA and other specifications. Forty-foot lengths fabricated without girth seams in diameters of 30 in. and above. Under 30 in., lengths of 22 ft furnished without girth seam, or 40-ft lengths with one girth seam. Diameters range from 20 in. to 120 in.

Use Alco Electric Welded Steel Pipe for your piping projects. Your nearest Alco Products Sales Representative will be happy to furnish you complete technical information and to discuss with you any special problems you may have.

Remember these Key features of Alco Steel Pipe

STRONG: Unaffected by vibration. Maximum resistance to shock, and to overloading due to earth movement and washouts.

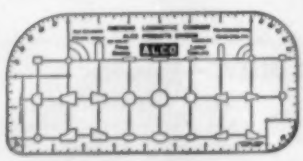
EFFICIENT: Positively watertight. Minimum number of field joints. Smooth surfaces for highest rate of flow.

ECONOMICAL: Low first cost. Long lengths, light weight, for easy installation.

DURABLE: Life in water-supply installations estimated conservatively at 75 to 100 years.

SUBMERGED-ARC WELDING gives added strength, zero leakage. Machine shown here is part of the complete, modern facilities that enable Alco to build low-cost pipe for almost any project.

PHILADELPHIA used efficient, durable Alco Electric Welded Steel Pipe in diameters of 60, 54 and 48 in., with thicknesses of ½ and ⅜ in. Sections are joined with Dresser couplings.



For information on how to obtain one of these handy Alco Piping Templates, write to your nearest Alco Products Sales Office.

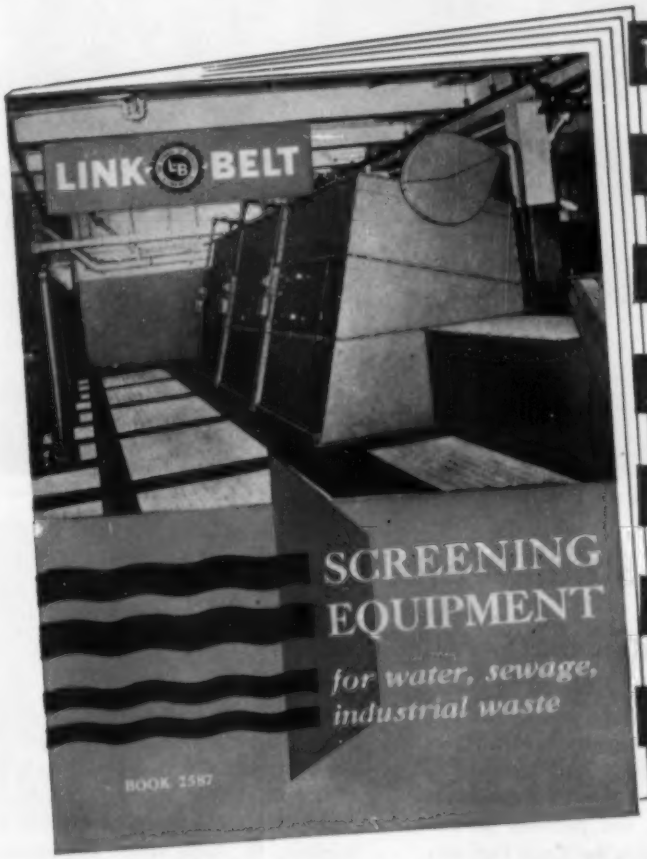
ALCO PRODUCTS

AMERICAN LOCOMOTIVE COMPANY

DUNKIRK, N. Y.

Sales Offices: New York, Chicago, Dunkirk, Los Angeles, Kansas City, Houston, Tulsa and Beaumont.

Send for *NEW* 28-page guide to LINK-BELT SCREENING EQUIPMENT



- Thru-Clean Screens
- Straightline Screens
- Trash Screens
- Tritor Screens
- Rotary Drum Screens
- Liquid Vibrating Screens
- Revolving Disc Screens

If your operations involve removal of solids from water, sewage or industrial waste — Link-Belt's new Book 2587 is important reading for you. It gives complete dimensions and specification data for four types of coarse screens for removing large solids . . . and three types of fine screens for small solids removal. To help determine your exact need, there are tables indicating the proper size unit for various capacities. In addition, Book 2587 contains over 30 photographs of screening installations and outstanding examples of Link-Belt sanitary engineering. Send for your copy now. Clip the coupon at right and mail today.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

13,750

WSW

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307 N. Michigan Ave., Chicago 1, Ill.
Please send a copy of New Book 2587 on Link-Belt Screening Equipment.

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Firm _____

Position _____

Address _____

City _____ *Zone* _____ *State* _____

Long string of 48-in. pipe being laid on 73rd Ave., bordering Alley Park. The small-diameter pipe in the picture is for local feed only.

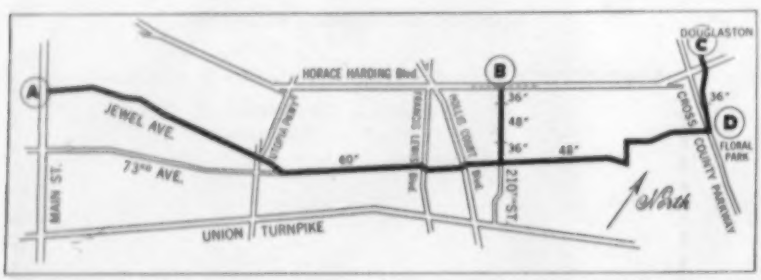
6-Mile Tar-Enameled Steel Water Main Under Way in Fast-Growing Queens, N. Y.

Few areas in the land have grown as fast as the Borough of Queens, New York City, which occupies the entire northwest section of Long Island. To keep pace with the resulting vastly increased water demands, the Bureau of Water Supply of the Department of Water Supply, Gas and Electricity is expanding its water supply system.

A major project which got under way in 1954 extends one of the Queens trunk mains from Main Street in Flushing 6 miles to the Douglaston Pumping Station, and provides for future development in the Floral Park area.

The new main consists of Bethlehem Tar-Enameled Steel Pipe of large diameters: 20,350 feet is 60 in. ID; 8,080 feet is 48 in. ID; and 2,860 feet is 36 in. ID. The pipe, in 40-ft lengths, was hydrostatically tested, coal-tar enameled inside and out, wrapped, and drilled for riveting at Bethlehem's Steelton, Pa., pipe shop. Bethlehem also supplied numerous bends, reducers and other pipe specials. Contractor for installation of the line was Tibbetts Contracting Corp. of Yonkers.

When you're planning your next water or sewage line, the wisest move you could make would be to pick up your phone and dial the nearest Bethlehem sales office. They will be happy to give you full information about Bethlehem Tar-Enameled Steel Pipe.



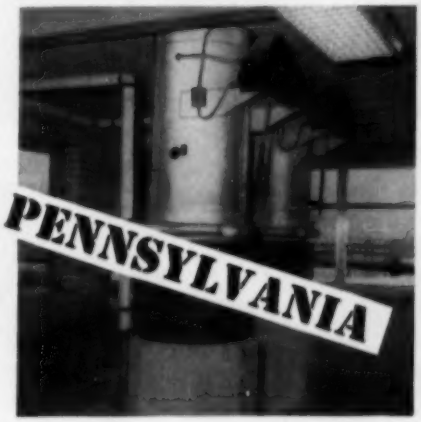
Simplified map shows the route of the new trunk main. Connecting with the existing 72-in. steel line at (A) and the existing 48-in. steel line at (B), it serves the entire area from Main St. to Douglaston at (C). Plans have already been made to supply the Floral Park area by tapping the main at (D).

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM *Tar-Enameled* **STEEL PIPE**



Universal in name... service... usefulness...

If you took a poll of the chemical feeders in water works service throughout the country, you would have dramatic proof of the popularity of Omega Universal Feeders. Here are a few of the hundreds of Universal Feeders which, today, are solving the chemical feeding problems of cities and towns in every state of the Union.

Are you acquainted with the many features of Omega Universal Feeders? If not, write for Bulletin 20-J10A.

Omega Machine Company, 350 Harris Ave., Providence 1, Rhode Island.

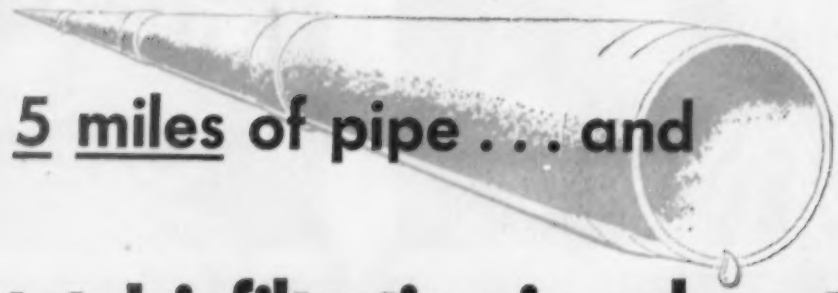
OMEGA *THE LAST WORD IN* **FEEDERS**

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • BUILDERS-PROVIDENCE, INC.

BIF METERS FEEDERS CONTROLS

16A



5 miles of pipe . . . and total infiltration is only a trickle . . .

. . . with Transite® Sewer Pipe

THE REDUCTION of ground-water infiltration brought about by the Ring-Tite® Joint—now standard on all sizes of Transite® Sewer Pipe—can lead to a number of cost-saving results.

For example, on one recently installed Ring-Tite System using 28,540 feet of Transite Sewer Pipe, in diameters of 6 through 18 inches, the infiltration per inch of diameter, per hour, per mile of pipe came to a mere 0.85 gal. This low infiltration (including that from manholes and connections to house sewers) was achieved despite the fact that a considerable portion of this installation was below the prevailing ground water table. (For specification purposes, an infiltration allowance of 10 gallons per inch of diameter, per hour, per mile of pipe may be used with Transite Sewer Pipe.)

Obviously, such minimum ground-water infiltration helps reduce the load on treatment plants, cuts down on treatment costs, and conserves plant capacity for future expansion needs. This reduced infiltration plus Transite's high flow capacity (Manning's N=.010) often permits the use of smaller diameter pipe for new installations.

For further information on how this Ring-Tite Joint, used with corrosion resistant asbestos-cement Transite Pipe can help reduce your sewage costs, write Johns-Manville, Box 60, New York 16, N. Y. Ask for folders TR-103A and TR-94A.

Tells more about Transite asbestos-cement Sewer Pipe with Ring-Tite joints—for non-pressure service. Ask for Brochure TR-103A.

Helpful to Engineers— Sewer Design Flow Chart Based on Manning Formula. Ask for Brochure TR-94A.

Johns-Manville TRANSITE SEWER PIPE

FAMOUS LIGHTHOUSES OF AMERICA

CAPE HENRY LIGHT, located on the south side of the entrance to Chesapeake Bay, was the first lighthouse to be built by the United States. The octagonal tower of sandstone, 129 feet high, was constructed of materials gathered while Virginia was still a colony. This original structure still stands, though it was damaged during the Civil War and is no longer in use. It was replaced in 1881 by the present lighthouse, a cast iron tower 167 feet high, located 337 feet to the northeast.

Pointing the way to progress in the development and use of electrochemicals is the pioneering research of Niagara Alkali Company. Niagara was the first in the country to produce several of these important materials and through research is constantly improving the usefulness of Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Caustic Soda, Nialk Paradichlorobenzene, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

NIAGARA ALKALI COMPANY

60 East 42nd Street, New York 17, N. Y.

"Century" Pipe, 4" Class 150, ready for laying in trench in Oakland, Oklahoma.

SMOOTH BORE

"CENTURY" PIPE

The smooth bore of "Century" Asbestos-Cement Pipe means less resistance to water flow and, consequently, lower pumping costs. Formed on a smooth steel mandrel, the pipe has an interior surface to match. The Williams and Hazen Constant "C" is conservatively placed at 140 for "Century" Asbestos-Cement Pipe. Being non-metallic, it cannot tuberculate.

More and more cost and tax conscious communities are recognizing the economy of "Century" Pipe. We will gladly furnish information about its advantages. Write today for a copy of our free booklet, "Mains Without Maintenance."

QUALITIES THAT MAKE "CENTURY" PIPE ECONOMICAL, TROUBLE-FREE, LONG-LIVED

1. NON-TUBERCULATING
2. NON-CORROSIVE
3. EXCEPTIONALLY STRONG
4. DURABLE
5. IMMUNE TO ELECTROLYSIS
6. TIGHT JOINTS
7. SMOOTH BORE
8. EASILY, QUICKLY LAID
9. LIGHT WEIGHT
10. LOW COST

"Century" Pipe meets the A.W.W.A., A.S.T.M. and Federal Specifications for asbestos-cement pressure pipe.

KEASBEY & MATTISON COMPANY • AMBLER • PENNSYLVANIA

Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873

K&M best in asbestos

The Men Who Install Johnston Pumps Know...

JOHNSTON
Vertical
PUMPS
are designed
to operate
longer
with minimum
repair and
power costs

...that they are designed by skilled engineers and built by master craftsmen to stand up under tough conditions. For nearly half a century, pump users have known that Johnston Pumps are economical to operate, easy to install and dependable in performance. Learn more about how Johnston can solve your pumping problems. Fill in and mail coupon today.

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VERTICAL PUMPS

JOHNSTON PUMP COMPANY
Founded in 1909
Bin "K", Pasadena 15, California

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WSW-36

Take the "sting" out of hydrant damage with DARLING QUIKFIX B-50-B's

HERE'S an unmatched combination for those locations where traffic mishaps are frequent. First, you gain all the unique advantages of Darling's standard B-50-B design, with its ball bearing operation and "O" ring seals. Easier, quicker operation . . . no packing gland maintenance . . . no water seepage to operating threads or bearings . . . no loss of lubricant.

And when destructive impact does occur, Darling's improved breakable barrel and valve rod couplings "take the rap". Both hydrant barrel sections remain undamaged and intact. Moreover, on-the-spot repair is a quick cinch. Note how the barrel coupling is segmented—four pieces —for easiest, minimum part replacement.

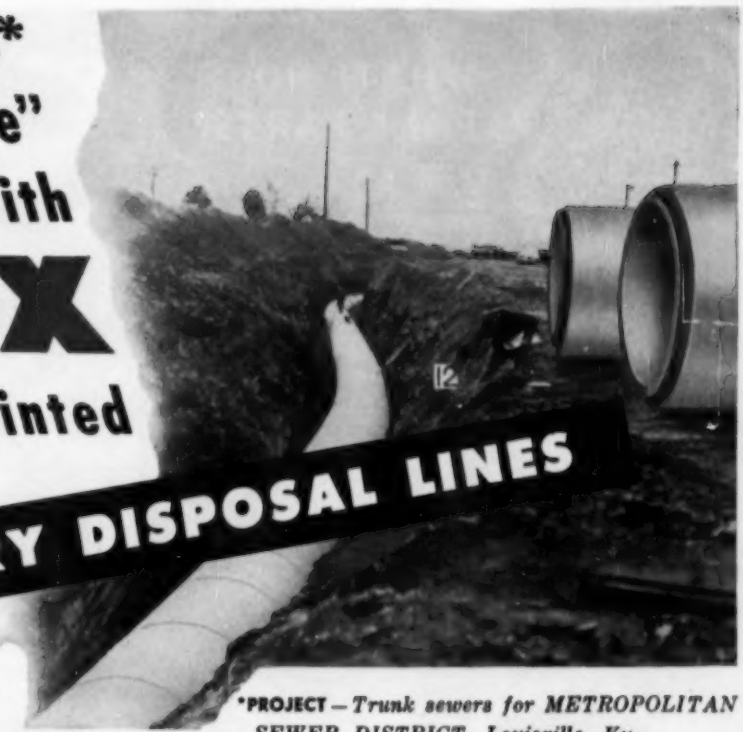
Better get *all* the facts about Darling QUIKFIX B-50-B's and see how *much* you can gain and save. Write:

DARLING VALVE & MANUFACTURING CO.

Williamsport 11, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

Louisville* "Plays Safe" with TYLOX Jointed SANITARY DISPOSAL LINES



*PROJECT — *Trunk sewers for METROPOLITAN SEWER DISTRICT, Louisville, Ky.*

ENGINEER—*Morris Forman, Chief Engineer*

PIPE—*Over 31,000 feet of 60" and 70" reinforced concrete pipe manufactured by Kentucky Concrete Pipe Company, Frankfort, Ky.*

CONTRACTORS—*Ruby Construction Company, Inc., and W. L. Hailey and Company, Inc., Louisville, Ky.*

When engineers and sanitary officials of the Louisville and Jefferson County Metropolitan Sewer District specified TYLOX RUBBER JOINTS for new trunk sewers, they "played safe" on three factors that mean a lot in protecting public funds invested in waste disposal projects. Their TYLOX decision automatically assured:—

No Infiltration — Passage of water **in or out** of the pipe joint is prevented by "compression-tight" Tylox Rubber Gaskets. Tylox Joints help reduce costs of sewage treatment.

No Joint Failures — The rubber of Tylox is specifically compounded to defeat sewerage and industrial waste corrosives. Under ground, and under compression, Tylox outlasts the pipe itself. Tylox helps reduce maintenance costs.

No Installation Delays — Flexible Tylox compensates for pipe angularities in any plane . . . permits wet-trench jointing and immediate backfilling. Tylox helps cut construction costs . . . keeps jobs ahead of schedule with **more pipe laid per day.**

TYLOX is the **one** Pipe Joint which fully meets requirements of engineers, sanitary officials and construction men alike.

MAKING JOINTS WITH TYLOX RUBBER GASKETS IS AS SIMPLE AS

A

Cement tongue and snap on TYLOX gasket.

B

Lubricate sliding surfaces with TYLOX cement.

C

Shove the pipe home to line and grade.

Specify TYLOX RUBBER JOINTS and play safe on your next pipe job. Write for full information and more TYLOX case histories TODAY.

HAMILTON KENT MANUFACTURING COMPANY

427 West Grant St., Kent, Ohio ORchard 3-9555

5000

When you buy HYDRANTS and VALVES for your city waterworks system...

LOOK TO THE YEARS AHEAD, TOO!

EDDY can supply replacement parts for any Eddy Valve or Hydrant ever installed! This is important to you because the Valves and Hydrants you buy today must serve several generations yet unborn. You want no "orphans" in your system. Eddy Hydrants and Eddy Valves are backed by Eddy Valve Company's 104 years of dependable operation—your assurance that replacement parts will be available during the years to come.

EDDY Bronze-Mounted HYDRANTS

are built for dependability and lasting service. They open smoothly *with* the pressure and close without water hammer. One man can easily remove all operating mechanism for inspection and repair. Positive drip action automatically drains the standpipe, safeguarding against freeze-ups. Stem held in place below main valve means no water loss due to a bent stem.

EDDY Bronze-Mounted GATE VALVES

offer simplicity of design, trouble-free operation and enduring service. From the engineering drawing boards through all stages of manufacture, they are step by step a truly "finished" product of workmanship. These factors, added to personal experience, are reasons why progressive water works men have relied on Eddy Valves for years.

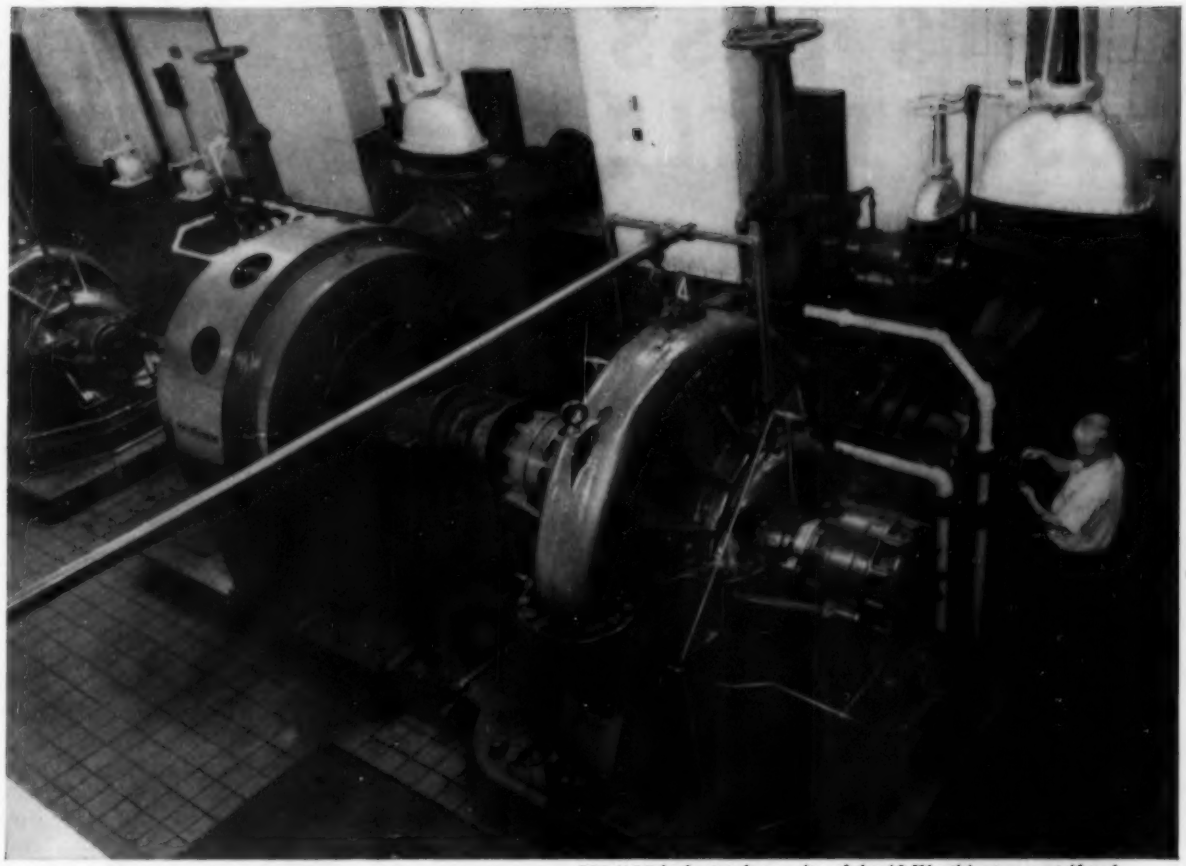
Eddy Hydrants and Valves are available with bell, flange or mechanical joint connections to fit any existing or planned installation.

Send today for full information on the complete line of Eddy Valves and Hydrants. No obligation.

EDDY VALVE COMPANY

A Subsidiary of James B. Clow & Sons

WATERFORD, NEW YORK



215 MGD is the total capacity of the 10 Worthington centrifugal pumps on the job in Philadelphia's modern Torresdale Station.

Philadelphia's newest pumping station has 10 Worthington centrifugals

Back in 1800 Philadelphians got along on 700,000 gallons of water a day.

It was pumped through 35 miles of wooden pipes from America's first municipally owned pumping station, located where City Hall now stands.

Today the city's water system has reached the point where just one of its 16 pumping stations — the modern Torresdale Station — can pump 215 million gallons of water a day into the 70-square-mile area it serves. That gallonage is the capacity of Torresdale's 10 electric-motor-driven Worthington centrifugal pumps which range in horsepower from 250 to 1750.

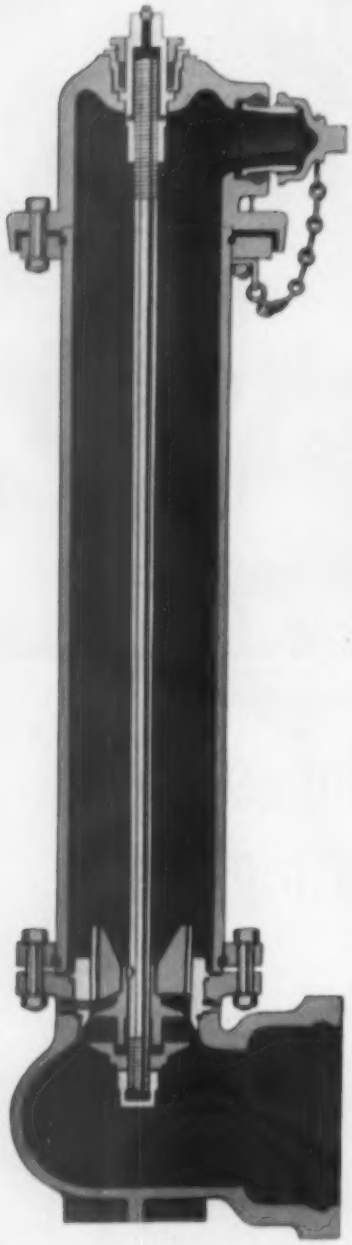
This is one more example of the tough assignments handed to Worthington water works equipment these days by municipalities on all sides. Whether the need is for pumps, comminutors, Diesels or turbines, there's a Worthington unit with design and construction features tested on a thousand jobs. There's more to be said, of course, and it's all in Bulletin WP-1099-B60. Write for it to Worthington Corporation, Public Works Division, Harrison, New Jersey, or get in touch with your nearest Worthington district office. W.4.2

WORTHINGTON

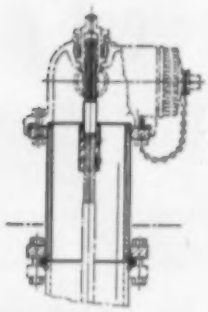
ALL MAJOR PUBLIC WORKS EQUIPMENT UNDER ONE RESPONSIBILITY

Water Works Pumps • Sewage Pumps • Comminutors • Vertical Turbine Pumps • Vacuum Pumps

COSTS LESS TO INSTALL
COSTS LITTLE TO MAINTAIN



A community can rest easy when it is protected by R. D. Wood Swivel-Joint Hydrants. Trouble can be a long time coming, but when it comes these great hydrants are ready. Installation and maintenance costs are low. They work instantly, reliably. Water-carrying areas are generously sized for full flow and maximum pressure. Every point of friction is protected by at least one bronze surface. Accurately formed threads and fitted parts make them interchangeable with other hydrants of the same size. Compression-type valve stops leakage when hydrant is broken in traffic accident.



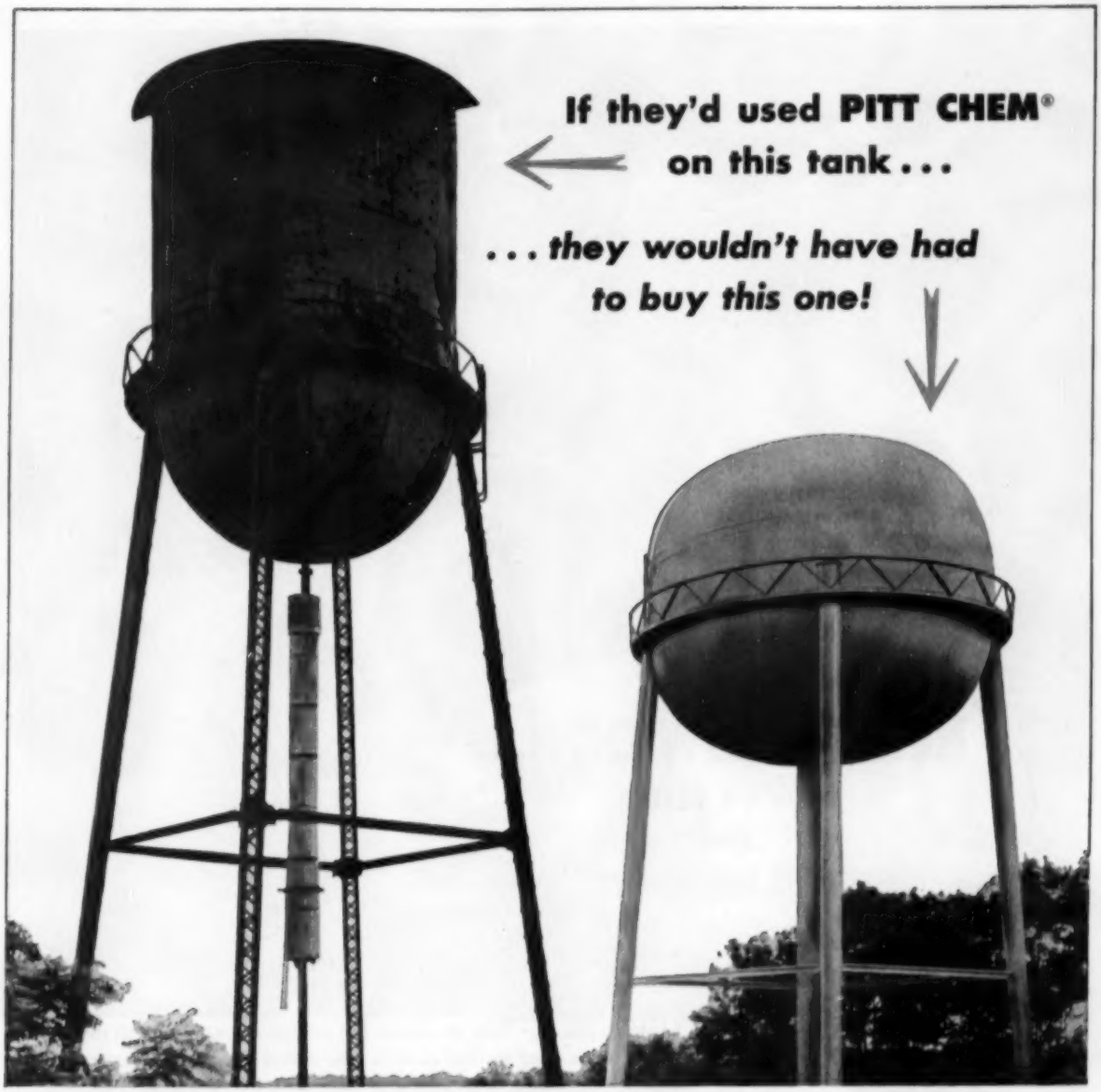
Extension piece can be inserted between hydrant head and barrel, or between barrel and elbow, without shutting off water supply.

Breakable flange and stem coupling can be furnished at extra cost. Both are constructed so that a heavy blow will snap the ring and coupling, thus saving more costly damage to the hydrant itself. Both can be replaced quickly and inexpensively with spares. No digging necessary.

R.D.Wood Swivel Joint Hydrants

Public Ledger Building, Philadelphia 5, Pa.
Manufacturers of "Sand-Spun" Pipe
(centrifugally cast in sand molds) and R. D. Wood Gate Valves

Send for this 80-page catalog. It contains full information about the R. D. Wood line of Cast Iron Pipe, Fire Hydrants, Gate Valves, and Hydraulic Machinery.



THEY TRIED to protect the water tank on the left with ordinary paint. That's why they had to recently erect its replacement on the right!

But *this* time they beat corrosion to the punch. A *Pitt Chem* engineer was called in prior to actual construction. Here's what he recommended: (1) Protect the tank interior with *Pitt Chem* 104—a tough, durable, water resistant coating that imparts no taste or odor to water. (2) Protect exterior tank surfaces with *Pitt Chem* 209 Alkyd Resin Aluminum Coating to combine attractive appearance with maximum resistance to atmospheric corrosion. (3) Protect the water pipe mains above ground and below with *Pitt Chem* 101, a thick, heavy duty tar base coating.

Thanks to *Pitt Chem,* the community is now assured of years of trouble-free service and maximum protection of their investment at minimum cost. Let us help you with *your* corrosion problems. ● Call or write today for technical information or engineering assistance.

W&D 5528

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Photo by Fairchild Aerial Surveys

NEW BRUNSWICK, N.J.

EQUIPS 8 FILTERS with POROUS UNDERDRAINS

*Information courtesy Mr. Chris C. Condon, Superintendent, New Brunswick Water Dept.

*A dozen years ago New Brunswick had mushroom strainers in all their gravity filters. They also had an acute case of sand clogging. Dangerously high pressures were often needed to clear the sand. And at best, backwashing was uneven. Mudballs and upset gravel were constant problems.

In 1943, they started to modernize their filters. They installed porous underdrains, using ALOXITE® aluminum oxide plates—one filter in 1943; one in '44; two in '46; two in '48; and two in '50. Today, all their filters have ALOXITE underdrain plates, and their previous difficulties have been eliminated. Backwashing now takes five minutes and only 5000 gallons of wash water per unit, where it used to take 12 minutes and twice as much water.

Our congratulations to New Brunswick on a well planned and executed program of modernization. The low operating and maintenance costs of their porous-plate underdrains should be tremendous assets for years to come.

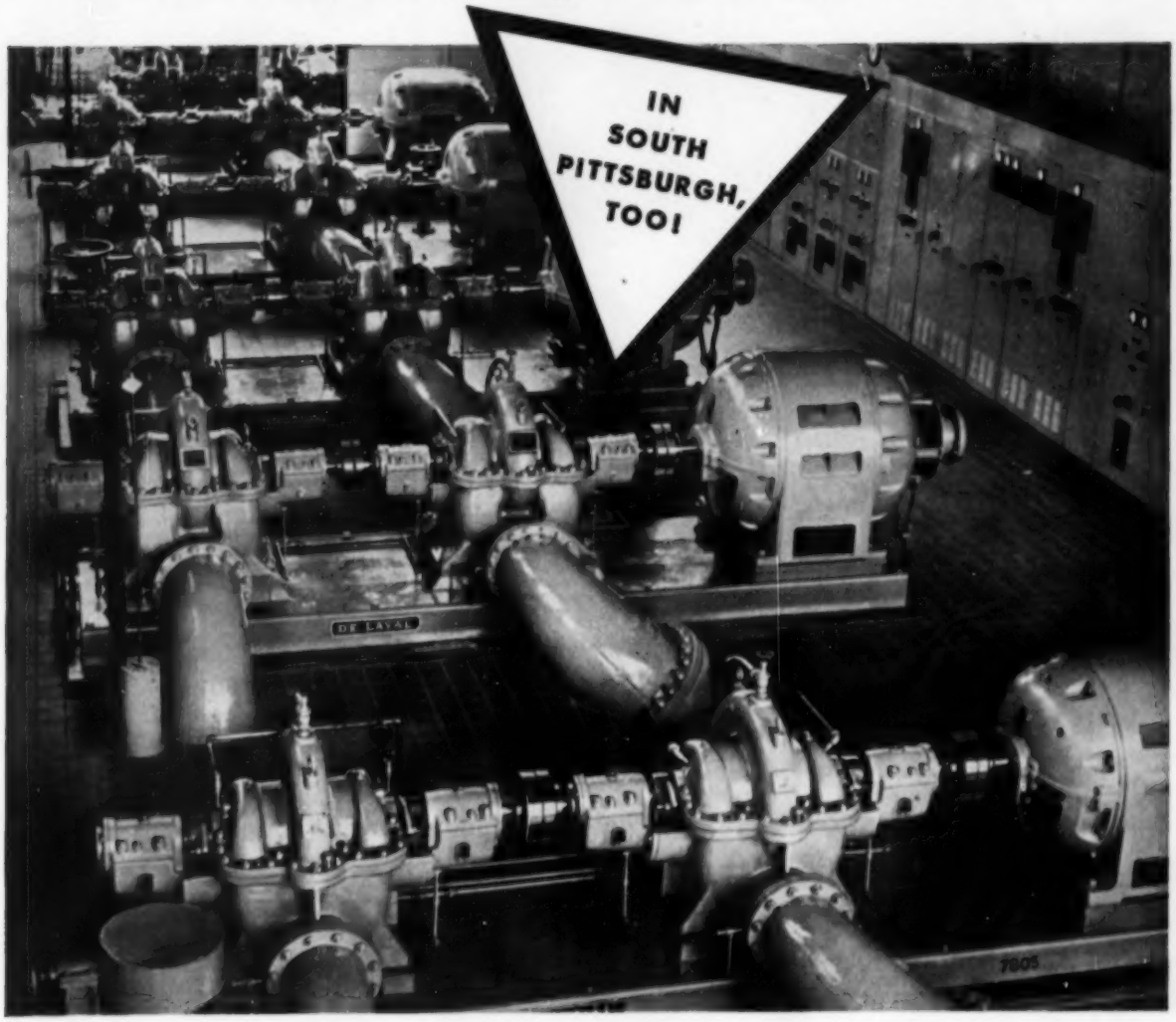
May we send you our popular booklet on porous media? Its 56 pages cover all fields of filtration and diffusion. No obligation, of course. Simply write to the address below.

CARBORUNDUM
Registered Trade Mark

Dept. X35, Refractories Division

The Carborundum Company, Perth Amboy, N. J.

DE LAVAL pumps America's water...



These five De Laval centrifugal pumping units, each consisting of two pumps in series, are installed in the Hays Mine Station of the South Pittsburgh Water Company. The unit in the foreground is designed for 5,400 gpm against a total head of 395 ft. at 1,200 rpm and is driven by a 600 hp motor. The other four units are identical, each designed for 9,000 gpm against a total head of 395 ft. at 1,200 rpm, and are each driven by a 1,000 hp motor.

More than 80% of America's cities depend on De Laval pumps to meet their water needs efficiently and economically. De Laval municipal pumping units range in capacity from 100 thousand to 100 million gallons per day.

NOTE:

Have you considered the dollars and cents savings you can make by replacing your old pumps with new, more efficient De Laval units? Write to De Laval for Pump Fax bulletin which includes a valuable "power savings" chart.

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

824 Nottingham Way, Trenton 2, New Jersey

DL-388

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reference

because

It is the only standard source of reference and data devoted to the Water, Sewage, and Industrial Waste Treatment field exclusively.

It is the only standard source of reference and data containing both editorial and buying information.

It has editorial material written by outstanding men in the field and compiled by outstanding editors.

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because

FOR THE READER . . . the reference & data edition offers specialized editorial content on every phase of his industry.

- Specialized charts and graphs.
- Specialized departments with "where to buy" information, Manufacturers' Index listing products, services, materials, etc., and "who makes them."
- Manufacturers' catalogs and buying information placed conveniently in the sections containing editorial material on related subjects.

All this in one easy-to-read volume and still included in the regular subscription to Water & Sewage Works magazine.

& data edition

because

FOR THE ADVERTISER . . . the reference & data edition offers the opportunity to place his buying material where it will do him the most good:

The book with the most devoted following in the field among the most influential buyers and users of his product or service.

Over 8,000 inquiries processed in the first two months after publication of the 1954 reference & data edition.

Buying information placed in the editorial section with related content written by outstanding men in the field.

The advertiser gets two chances to have his material seen by every reader: FIRST when the reader is looking for buying information, and AGAIN when the reader is looking for editorial material.

Make use of the bigger and better 1955 edition which will be published in May. Your schedule in Water & Sewage Works magazine will earn you a special rate in the reference & data edition.

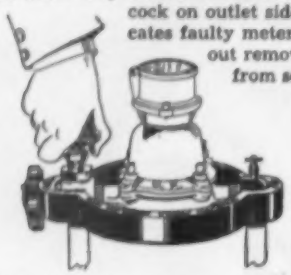
Include the "R&D" in your 1955 schedule.

SCRANTON PUBLISHING CO. • OFFICES • 155 EAST 44TH STREET, NEW YORK 17, N. Y.
185 NORTH WABASH AVE., CHICAGO 1, ILL.

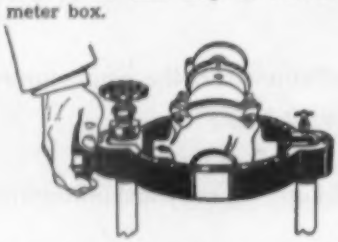
Meter Installation And Removal Now Simplified

With the use of Clark Meter Yokes, installation or removal of meter is a simple job requiring only a few seconds' time. Only one hand is needed, assuring ample visibility in the box.

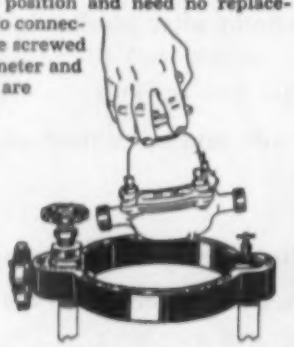
Closing Valve. A few easy turns close the water-way without use of tools. Try-cock on outlet side indicates faulty meter without removing it from service.



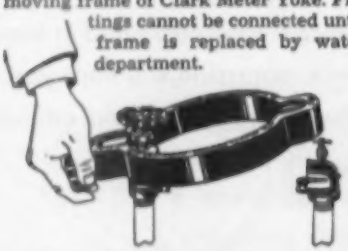
Releasing Meter is accomplished with a few turns of handwheel. Meter tips and rests on yoke frame. It cannot fall over frame and drop to bottom of meter box.



Removing Meter. Just lift out. Gaskets stay in position and need no replacement. No connections are screwed on the meter and no tools are needed.

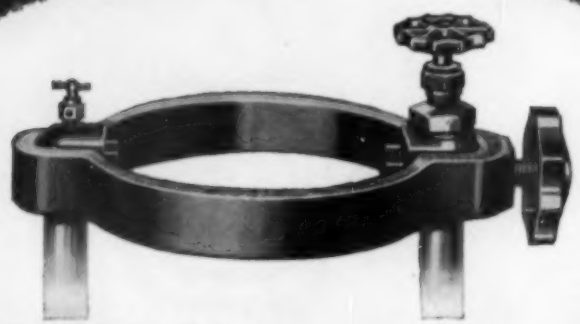


Sealing Service is accomplished by removing frame of Clark Meter Yoke. Fittings cannot be connected until frame is replaced by water department.

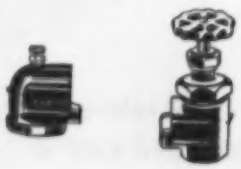


For further details and features of these time-saving meter yokes, we suggest that you write the manufacturer, H. W. Clark Co., Mattoon, Illinois . . . mentioning this article and publication.

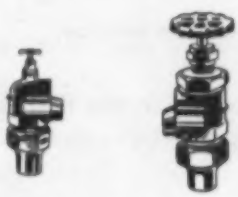
CLARK METER YOKES
For Easy One-Hand Operation



No. 4 CLARK METER YOKE. Installation is made without bolts, rivets or screws. Outlet try-cock ell determines condition of meter and inlet control valve ell facilitates easy exchange of meters.



Try-cock Ell Valve Ell



Bronze Ell and Valve with Copper Connections.

SPACER CLAMP ties riser pipes together rigidly at bottom of meter box and automatically liberates meter when handwheel is loosened.

Thanks to simplified design and construction, Clark Meter Yokes permit easy one-hand operation. They are manufactured in a minimum number of sizes to meet every requirement of simplified operation. Because they eliminate so many parts, Clark Meter Yokes are also economical. Costs of meter couplings, curb stop, service box and several pipe fittings are saved. Circular one-piece cast iron frames give added strength, and these yokes are quickly installed on any type of service line. Available for either iron or copper pipe. To get all the details . . .

Write

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MATTOON, ILLINOIS

Digester and control building of the new Hobart plant completed in August, 1953

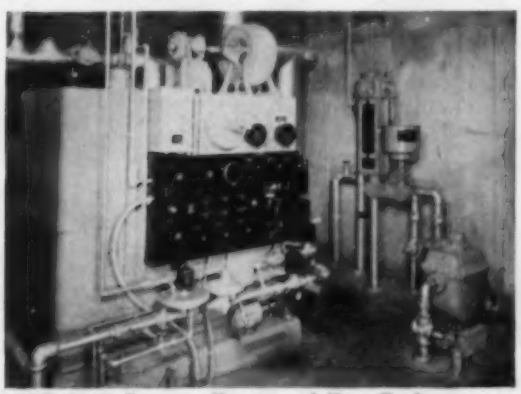
Hobart, Indiana Builds for Modern Sewage Treatment

WITH PFT "CONTROLLED DIGESTION"

Designed for a population equivalent of 12,000, Hobart's impressive new activated sludge plant provides modern, effective treatment. A complete line of PFT equipment is installed for up-to-date "controlled digestion!"

A *PFT Floating Cover* is installed in the 50′ digester (49,880 cu. ft. capacity) for simplicity of operation, positive scum submergence and safe utilization of gas. A *PFT Cover Position Indicator* with high and low level alarms shows the digester liquid level at a glance.

A *PFT Supernatant Selector* with *Gauge, Sight Glass and Sampler* unit provides for automatic withdrawal of the best digester liquor.



PFT #250 Digester Heater and Heat Exchanger

An effective part of Hobart's "controlled digestion" is the *PFT Heater & Heat Exchanger* (250,000 B.t.u. per hour). Fired by gas *or* oil, it cuts fuel costs by utilizing all sludge gas produced, switching to oil only when necessary to maintain optimum temperatures of 90° to 95°.

PFT Gas Safety Equipment in the plant includes: 3″ Waste Gas Burner; Flame Trap; Pressure Relief with Flame Trap; Flame Cell; Drip Taps; Gas Pressure Gauge.

At Hobart, as in all its installations, PFT assisted consulting engineers by showing the adaptability of its equipment in meeting specific plant requirements. PFT checks the installation of its equipment and stands squarely behind its successful operation.

Design of plant by / *Consoer, Townsend & Associates, Chicago*

P.F.T.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO.
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tioning this article and publication.

"Little Boomer": Oliver OC-3 crawler and hydraulic boom do real big job

Nicknamed the "Little Boomer", this Oliver OC-3 with hydraulic sideboom is proving highly successful on all types of light pipelaying operations.

The OC-3 is a tough, compact crawler that packs a big 21.85 drawbar h.p. Its size and weight handle a surprising amount of heavy-duty work, yet it is easily and inexpensively transported from job to job on a light trailer or truck.

Differential steering on the OC-3 keeps power on both tracks, even on turns. You can edge up to the ditch smoothly without jerking. Crawler traction lets you work in all conditions. And the OC-3 handles as easily as a car and maneuvers quickly in tight quarters.

Side-boom action is hydraulically controlled so you can lift or lower with accurate control. Only two controls operate the boom. Even an inexperienced operator becomes an expert in a short time. Investigate the "Little Boomer" for your work. See your Oliver Industrial Distributor for complete details.

Power on both tracks at all times plus extra-high clearance enable the OC-3 crawler to work in hard-to-get-at places. Note street pads on tracks that prevent damage to roads or turf. Hydraulic sideboom manufactured by Midwestern Engine & Equipment Co., Inc.

THE OLIVER CORPORATION
400 W. Madison Street, Chicago 6, Illinois

OLIVER

A complete line of industrial wheel and crawler tractors

"American Meters are the most simple and practical Meters I have ever used. They have fewer working parts. In looking ahead as Water Works Superintendent, I feel confident that I'll never be criticized for buying American."

The Safest Meter to Buy is AMERICAN

Because of LONG LIFE

• Experience is the best teacher. Water Department heads, when they have found a sure thing — stick to it. That's why more and more superintendents, with years of experience, buy American with the full knowledge that 10, 20 even 30 years from now, those same meters will be giving dependable service. It's always safest to buy American.

BUFFALO METER CO.

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Red Water?

CONTROL IT WITH *Calgon*

Corrosion?

CONTROL IT WITH *Calgon*

Tuberculation?

CONTROL IT WITH *Calgon*

Calgon* provides the simple, effective and *economical* answer to these and many other water works problems. Calgon stabilizes iron and manganese dissolved in water, prevents iron pickup from pipes—Red water is stopped.

Corrosion control with Calgon† is effective against tuberculation, keeps flows high and pumping costs low. Call on Calgon for the solution to your specific problem. Years of experience with water problems of all types in every part of the country are at your service.

*Calgon is the Registered Trade Mark of Calgon, Inc. for its glassy phosphate (sodium hexametaphosphate) products.
†Fully licensed for use under U.S. Patent 2,337,856 and 2,304,850.

HAGAN HALL BUROMIN CALGON

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A SUBSIDIARY OF HAGAN CORPORATION
HAGAN BUILDING • PITTSBURGH 30, PA.

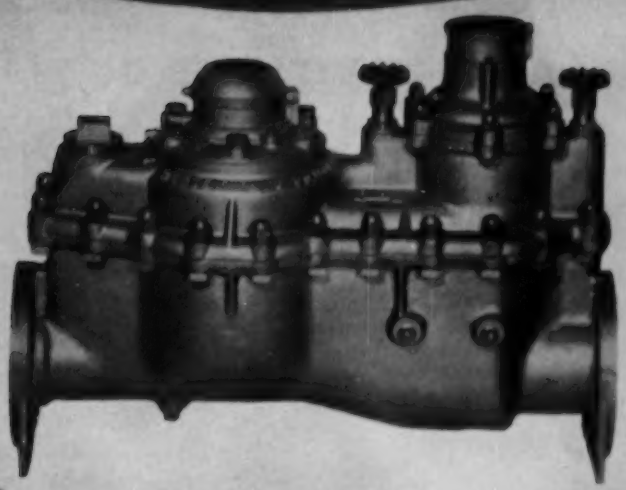
When you buy a Compound Meter, be sure it's a

HERSEY COMPOUND METER

the meter that registers accurately all rates of flow.

All bronze case from 2" to 6"

HERSEY



HERSEY MANUFACTURING COMPANY

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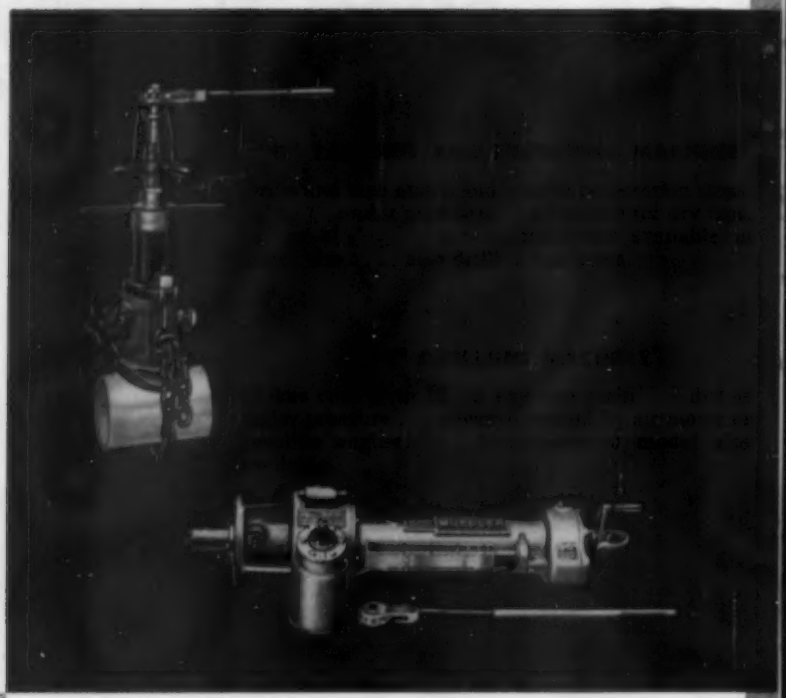

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Low maintenance and high efficiency are characteristic of all Mueller water works equipment, supplies and specialities. Each item is engineered to do its specific job and is manufactured from the finest materials — guaranteeing long, trouble-free life. A high degree of standardization and interchangeability requires a minimum inventory of replacement parts in case of accident or emergency. Mueller's complete line of products, a few of which are shown, provides a single source for your water works needs. All products are fully tested and warranted.

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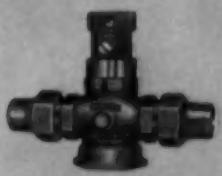
Designed for insertion into mains under pressure . . . ground key . . . complete range of sizes and types . . . variety of inlet and outlet threads and connections.

SERVICE CLAMPS

For use on all types of pipe . . . single or double strap . . . full depth tapped hole . . . Neoprene or lead ring gasket . . . all sizes and threads available.

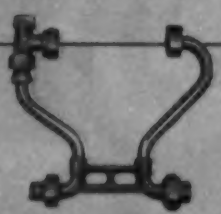
CURB BOXES

Telescoping type . . . prevents damage to stop or piping . . . large steel upper section will not revolve in base. Bronze-to-iron threads for easy plug or lid removal . . . with or without stationary rod.



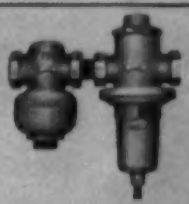
CURB STOPS

Ground key stops . . . proper taper prevents sticking . . . allows easy operation . . . inverted key or solid tee head type . . . complete range of sizes, types and connections.



METER SETTING EQUIPMENT

Copper meter yoke with multi-purpose end connection . . . iron meter yokes . . . plain or lock wing angle stops . . . meter couplings . . . complete line available . . . variety of inlets and outlets.



REGULATORS AND RELIEF VALVES

Large diaphragm type . . . all working parts accessible without removing from line . . . high or low pressure . . . for water, air, gas or oil.

FIRE HYDRANTS

AWWA improved and standard types, sizes to 6¼" valve opening . . . compression type . . . locked-in nozzles . . . safety flange minimizes collision damage . . . 2½", flush type and Underwriter Approved also available . . . AWWA.

GATE VALVES

Exclusive "four-point contact" disc wedging mechanism . . . fully bronze-mounted . . . conventional or "O" ring stem packing . . . rising or non-rising stem . . . AWWA.

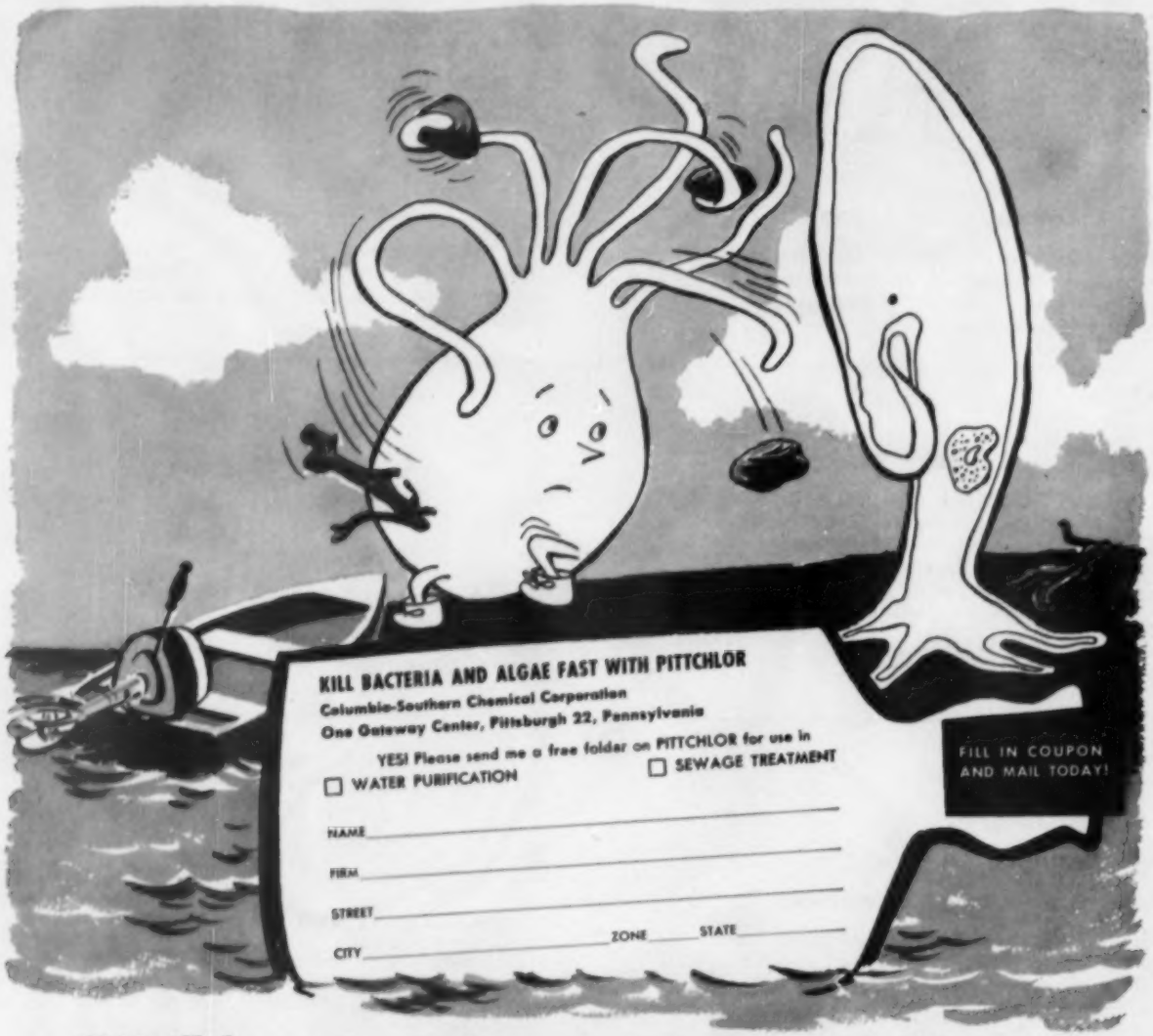
INSERTING VALVES

Designed for installing in line without a shutdown . . . operated like gate valve after installation . . . parts interchangeable with AWWA gate valve . . . 4", 6" and 8" sizes.

MUELLER CO.

Dependable Since 1857

MAIN OFFICE & FACTORY DECATUR, ILLINOIS



"We'll have to make a quick getaway, Orgie, if that PITTCHLOR® *coupon gets through!"*

Yes Sir, Algae, you and Orgie had better keep the motor running if you value your lives.

Pittchlor is certain doom to chlorine-susceptible bacteria and algae.

A high-test calcium hypochlorite containing a minimum of 70% available chlorine, Pittchlor works fast and effectively in chlorinating water supplies, treating sewage, or wherever the germicidal and deodorizing action of chlorine is needed.

Pittchlor is dry, white and free-flowing. Its granular form permits ease of application either manually or by mechanical feeders. Send in the coupon . . . or see your jobber right away!

FOR
WATER PURIFICATION
SEWAGE TREATMENT
SWIMMING POOL
SANITATION

Stocked by leading jobbers in 5 lb. resealable cans (9 per case), 3¼ lb. cans (12 per case) and 100 lb. and 130 lb. drums.

DISTRICT OFFICES: Cincinnati
Charlotte • Chicago • Cleveland
Boston • New York • St. Louis
Minneapolis • New Orleans
Philadelphia • Houston • Pittsburgh
Dallas • San Francisco

COLUMBIA-SOUTHERN CHEMICAL CORPORATION

SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY

ONE GATEWAY CENTER · PITTSBURGH 22 · PENNSYLVANIA

—by PITTSBURGH • DES MOINES

This monumental 2,500,000-gallon elevated steel tank provides balanced water storage for a large suburban area served by South Pittsburgh Water Company, Pittsburgh, Pa. Of Radial Cone Bottom design, the structure typifies in perfection of engineering and craftsmanship the quality provided by Pittsburgh-Des Moines Elevated Steel Tanks of every type. • Write for our complete *Modern Water Storage* brochure, without obligation.

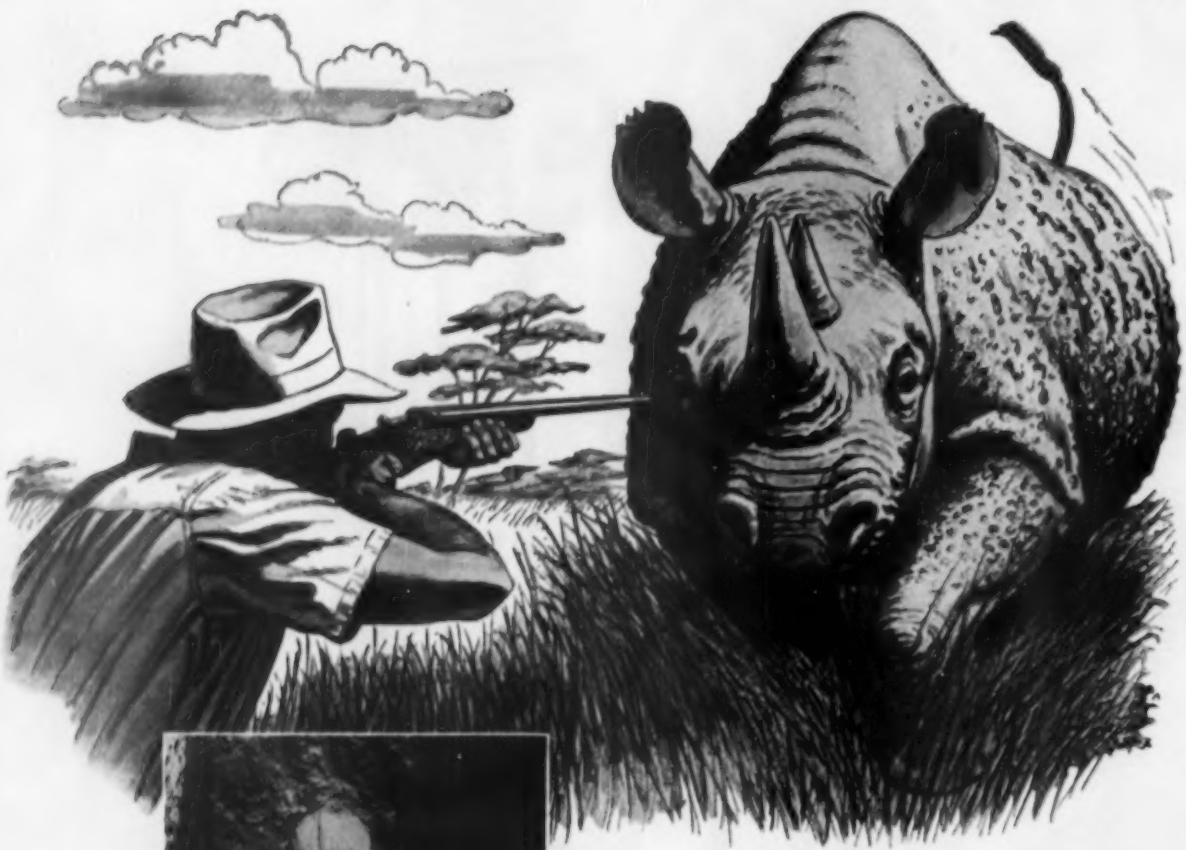
PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES and SANTA CLARA

Sales Offices at:

PITTSBURGH (25) ..... 3418 Neville Island
NEWARK (2) ..... 218 Industrial Office Bldg.
CHICAGO (3) .. 1222 First National Bank Bldg.
LOS ANGELES (48) ..... 6399 Wilshire Blvd.
DES MOINES (8) ..... 919 Tuttle Street
DALLAS (1) ..... 1223 Praetorian Bldg.
SEATTLE ..... 526 Lane Street
SANTA CLARA, CAL. ..... 625 Alviso Road

what have they



The rhino lives in wooded, watery districts of Africa and Asia. Its temper is short, its eyesight dim but its scent and hearing are very acute. Though heavy, it is extremely fleet of foot. It feeds mostly at night and its diet is largely vegetarian.

This cast iron main laid in Richmond in 1830 is still functioning after more than a century of service.

MODERNIZED cast iron

NEWARK (2) . . . . 218 Industrial Office Bldg.
CHICAGO (3) . . 1222 First National Bank Bldg.
LOS ANGELES (48) . . . . . 6399 Wilshire Blvd.
DALLAS (1) . . . . . 1223 Praetorian Bldg.
SEATTLE . . . . . 526 Lane Street
SANTA CLARA, CAL. . . . . 625 Alviso Road

in common . . .

THE RHINO AND CAST IRON PIPE . . . TOUGHNESS!

The thick, tough hide of the rhinoceros makes it one of the hardest animals to bring down. Toughness is also a dominant feature of CAST IRON PIPE. It serves for centuries.

AND HERE'S PROOF! Listed below are some of the many water utilities still using cast iron pipe that was installed a century or more ago.

DEPARTMENT OF WATER AND WATER SUPPLY, City of Albany, New York
ALEXANDRIA WATER COMPANY, Alexandria, Virginia
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Baltimore, Maryland
PUBLIC WORKS DEPT., WATER DIVISION, Boston, Massachusetts
DEPARTMENT OF PUBLIC WORKS, DIVISION OF WATER, Buffalo, N. Y.
WATER WORKS DEPARTMENT, Chicago
COLUMBIA WATER COMPANY, Columbia, Pennsylvania
BOARD OF WATER COMMISSIONERS, Detroit, Michigan
CITY OF FREDERICK WATER DEPT., Frederick, Maryland
PUBLIC SERVICE COMMISSION, City of Halifax, N.S., Public Water Supply
WATER BUREAU OF THE METROPOLITAN DISTRICT, Hartford, Connecticut
MUNICIPAL WATER WORKS, Huntsville, Alabama
BUREAU OF WATER, Lancaster, Pennsylvania
CITY OF LYNCHBURG WATER DEPARTMENT, Lynchburg, Virginia
MOBILE WATER WORKS COMPANY, Mobile, Alabama
QUEBEC HYDRO-ELECTRIC COMMISSION, Montreal, Quebec
PUBLIC WORKS DEPT., WATER-WORKS & SEWERAGE DIV., Montreal, Quebec
WATERWORKS DEPARTMENT, City of Nashville, Tennessee
DEPT. OF WATER, GAS & ELECTRICITY, New York, New York
DEPT. OF PUBLIC WORKS, BUREAU OF WATER, Philadelphia, Pennsylvania
BUREAU OF WATER, DEPT. OF PUBLIC WORKS, Pittsburgh, Pennsylvania
POTTSVILLE WATER COMPANY, Pottsville, Pennsylvania
BUREAU OF WATER, Reading, Pennsylvania
DEPT. OF PUBLIC UTILITIES (WATER), Richmond, Virginia
DIVISION OF WATER & SEWERS, Sacramento, California
WATER & SEWERAGE DEPARTMENT, City of Saint John, N.B.
DEPT. OF PUBLIC UTILITIES, WATER DIVISION, St. Louis, Missouri
WATER DIVISION, DEPT. OF ENGINEERING, Syracuse, New York
DEPT. OF PUBLIC WORKS, Troy, New York
CITY OF UTICA, BOARD OF WATER SUPPLY, Utica, New York
CITY OF WHEELING WATER DEPT., Wheeling, West Virginia
WILMINGTON WATER DEPT., Wilmington, Delaware
WATER DEPARTMENT, City of Winchester, Virginia
WATER DEPARTMENT, City of Winston-Salem, North Carolina
YORK WATER COMPANY, York, Pennsylvania
WATER DEPARTMENT, City of Zanesville, Ohio

TODAY . . . modernized cast iron pipe, centrifugally cast, is even tougher, stronger, more uniform. *Where needed and specified,* it is centrifugally lined with cement mortar to assure sustained carrying capacity throughout its long years of service.

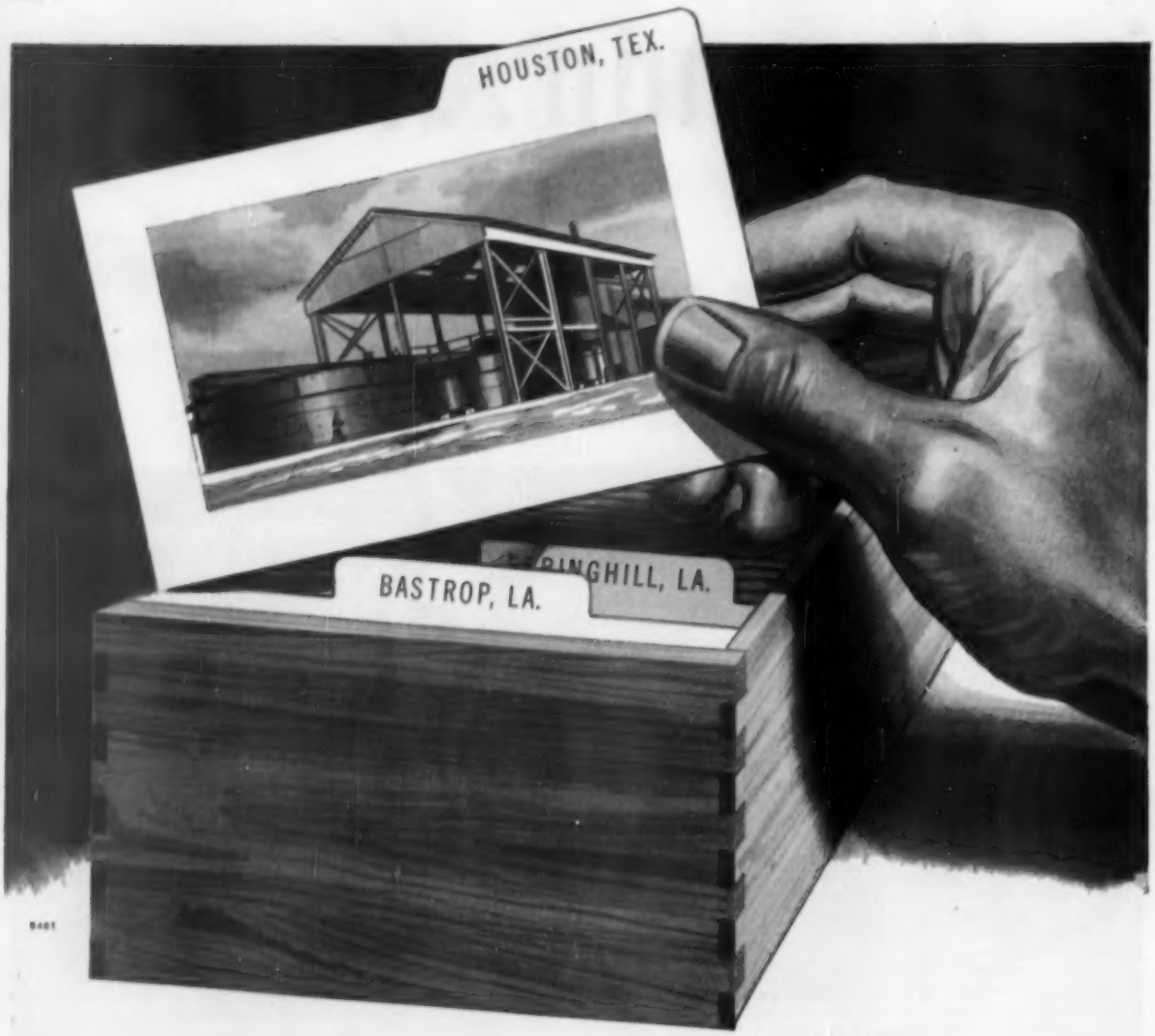
On its record, CAST IRON PIPE is the world's most dependable carrier of water.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director,
122 So. Michigan Avenue, Chicago 3.

CAST Q IRON

The Q-Check stencilled on pipe is the Registered Service Mark of the Cast Iron Pipe Research Association.

pipe FOR MODERN WATER WORKS OPERATION



A new source for Consolidated Alum . . .

To answer the rapidly increasing demand for aluminum sulphate in the industrial Southwest, Consolidated has recently completed this alum liquor plant at Houston.

The plant is the first of its kind in Texas; it incorporates all the applicable advances in efficiency and quality-control which Consolidated has developed in its 75-year history. For only one example: The plant gets its sulphuric acid from the company's unique acid regeneration units which produce new white acid from what was formerly waste sludge.

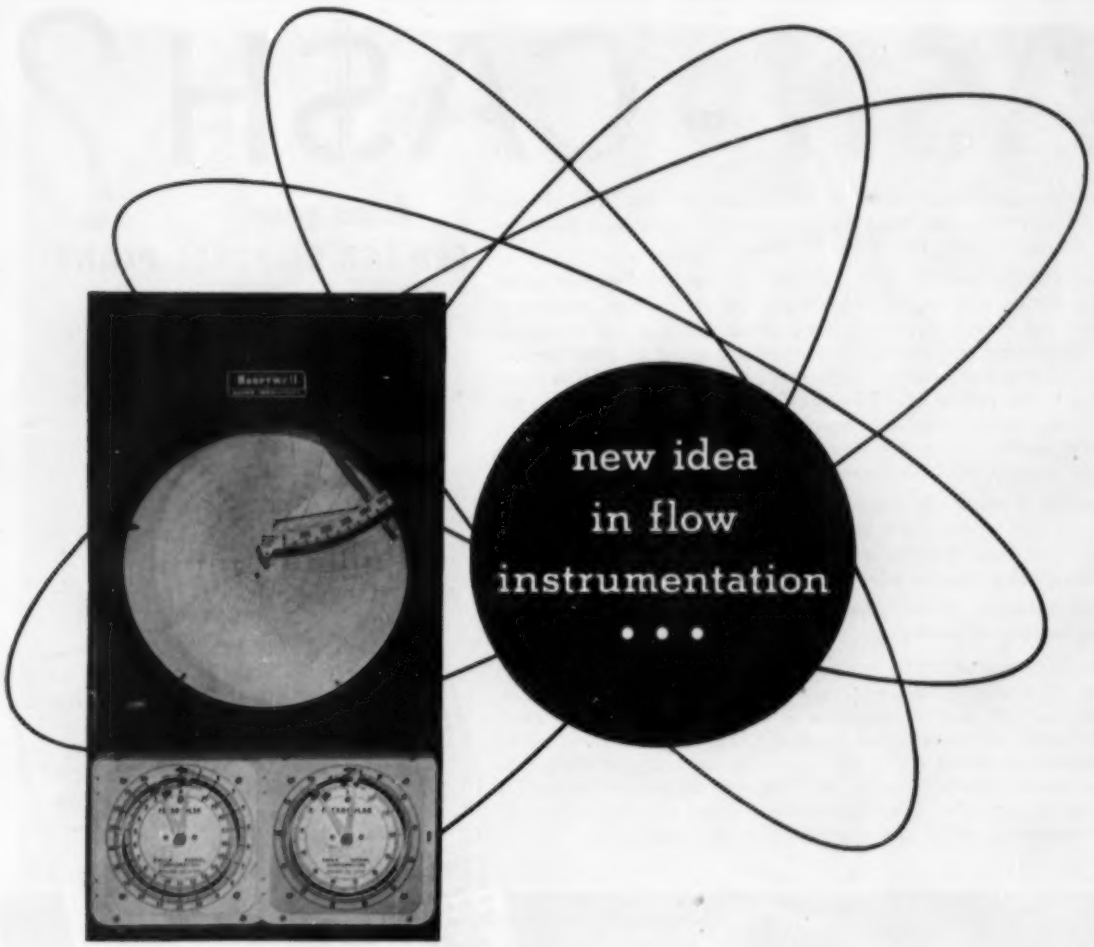
Other large alum plants are strategically located at Bastrop and Springhill, Louisiana, where Consolidated has long produced this important industrial chemical.

Used as a filtering agent in Houston's new surface water system, Consolidated Alum is vital also in treating raw water for industrial use . . . as a fiber binder in paper-making . . . and in many other industrial processes.

Consolidated's experience . . . plus its ever-broadening facilities . . . may be the answer to *your* alum requirements.

CONSOLIDATED CHEMICAL INDUSTRIES INC.

640 ESPERSON BUILDING • HOUSTON 2, TEXAS
380 MADISON AVE. • NEW YORK 17, NEW YORK
SULPHURIC ACID • MURIATIC ACID • ALUMINUM SULPHATE • BONE BLACK



provides automatic sequence control

WATER treatment processes and sewage disposal plants will find many applications for this new addition to the line of Brown flow instruments. Consisting of a flow recorder with electronic integration, this instrumentation initiates control action whenever a specified volume of fluid is transferred. It can be used, for example, to start chemical feeders when a preset gallonage of water is pumped into a treatment tank . . . and then to shut off the feeder after a pre-determined running time.

Useful in both batch and continuous operations, this instrumentation places on an accurate, automatic basis many processes which have always required constant attention by operators. It not only eliminates the danger of human errors, but also frees personnel for other more responsible duties.

Control starts from the integrated measurement. When a given volume (or poundage) has been transferred, a timer is actuated to start the related control circuit. Many variations are possible, to afford control based either on constant feed for a variable time duration, or on variable feed. The control instrument can be a flow-measuring model; or if transfer of solids is involved, any of several systems for continuous weighing of materials on conveyors can be utilized.

Your local Honeywell sales engineer will be glad to discuss applications to specific problems, with you and your consulting engineer. Call him at your nearby Honeywell office . . . as near to you as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Instrumentation Data Sheet No. 11.12-1.**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS

H HONEYWELL

First in Controls

ASH or CA$H?

from your SEWAGE DISPOSAL PLANT

The new sewage disposal plant in Wyomissing Valley, Pennsylvania (Albright and Friel, Philadelphia, consultants), could have been designed for incineration. But it wasn't. Here's why.

It was known that the sludge would be free from contaminants. By flash drying and selling this sludge, the plant could perform a service to the community and to itself. Dried sludge is rich in humus, is easy to handle and contains the elements found in good topsoil. After being dried, an excellent organic soil conditioner could be made available to the public at a reasonable price. At the same time, the expenses of incineration – ash handling and disposal, for example – would be avoided while the revenue from the sale of dried sludge would help offset operating expense.

Naturally Wyomissing Valley chose cash not ash. And, since the plant is located within a few hundred feet of a new apartment development a C-E high temperature deodorization system is incorporated in the design to guarantee odor-free operation.

Actual operation of this plant has confirmed the wisdom of the decision made in Wyomissing.

In communities where the character of the sludge makes it unsuitable for use as a soil conditioner, incineration may be the only answer. But, whether you plan to incinerate or dry, the C-E Raymond Flash Drying System can be designed to allow you to do either at will. Like the communities listed at the right, you too can end your sludge disposal problems effectively and at less cost with the service-proved C-E Raymond System. For full information, contact the C-E Raymond office nearest you. A C-E specialist will be glad to help you.

B-810

Wyomissing Valley picked CA$H

C-E

C-E RAYMOND FLASH DRYING SYSTEMS PRODUCING FERTILIZER

CITY	TREATMENT	NO. UNITS	SIZE OF UNITS Lb. Water per Hour Per Unit	INSTALLED CAPACITY Tons Fertilizer Per Year
Baltimore, Maryland	Act. Dig.	3		
Battle Creek, Michigan	Pri. Dig.	1	6,140	20,000
Chicago, Illinois Calumet	Activated		2,370	2,550
Southwest	Activated	2		
Southwest Ext.	Activated	8	6,667	
Edgewater, New Jersey	Pri. Dig.	6	21,000	15,850
Fond Du Lac, Wisconsin	Pri. Dig.	1	21,000	148,500
Houston, Texas	Activated	1	795	48,500
Lansing, Michigan	Act. Dig. & Garbage	2	2,350	150
Los Angeles, California	Act. Dig.	1	12,000	1,300
Recife, Brazil	Pri. Dig.		6,667	30,400
San Diego, California #1 Plant		4		6,790
#2 Plant	Pri. Dig.	1	22,500	
San Francisco, California	Pri. Dig.		943	79,500
Schenectady, N. Y.	Pri. Dig.	1		1,280
Sheboygan, Wisconsin	Pri. Dig.	1	2,500	
Stamford, Connecticut	Pri. Dig.	3	5,000	7,500
Washington, D. C.	Pri. Dig.	1	6,250	13,200
	Pri. Dig.	1	3,370	38,400
Wyomissing, Pennsylvania	Pri. Dig. now Act. Dig. later	1	3,640	2,870
	Pri. Dig.	3	3,330	3,080
		1	12,000	1,780
				65,500
			9,218	
				648

COMBUSTION ENGINEERING

RAYMOND DIVISION

1315 North Branch Street, Chicago 22, Illinois

Eastern Office: 200 Madison Avenue, New York 16, New York • Western Office: 510 West Sixth Street, Los Angeles 14, California

ALSO FLASH DRYING AND INCINERATION SYSTEMS FOR INDUSTRIAL WASTE DISPOSAL

Giant crops *of microscopic algae . . . rich in vital food elements . . . grown under the sea to help feed a hungry world. Scientists say it will come.*

100 years from now... WE'LL "FARM" THE SEA TO FEED A HUNGRY WORLD!

Hard to imagine. But in the fabulous world of tomorrow, there'll be one familiar note: water and gas will still be carried by the dependable, cast iron pipe laid today. Over sixty American cities still use cast iron water and gas mains a century and more old. And today, U.S. Pipe...centrifugally cast and quality-controlled from mines to blast furnaces to finished product...is even tougher, stronger, more durable.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.

U.S.
cast iron
PIPE
FOR WATER, GAS, SEWERAGE AND INDUSTRIAL SERVICE
CAST IRON

U. S. PIPE AND FOUNDRY CO., General Office: Birmingham, Alabama
A wholly integrated producer from mines and blast furnaces to finished pipe.

NOW - for complete plastic pipe service - just call Continental

MILLS PLASTIC I (SARAN)

FLEXIBLE – for air, oil and water lines, lubricating systems, food handling, beverages, vitamin oils and drugs, electrical raceways, etc.

MILLS PLASTIC III (BUTYRATE)

SEMI-RIGID – for salt-water disposal, vent lines, city water lines, renewal liners for gas lines, corrosive liquids and gases.

MILLS PLASTIC IV (POLYETHYLENE)

FLEXIBLE – for municipal water systems, two-pipe jet well transmission, underground water service, irrigation, transmission of corrosive gases, vapor, air, etc.

MILLS PLASTIC V (STYRENE-ALLOY)

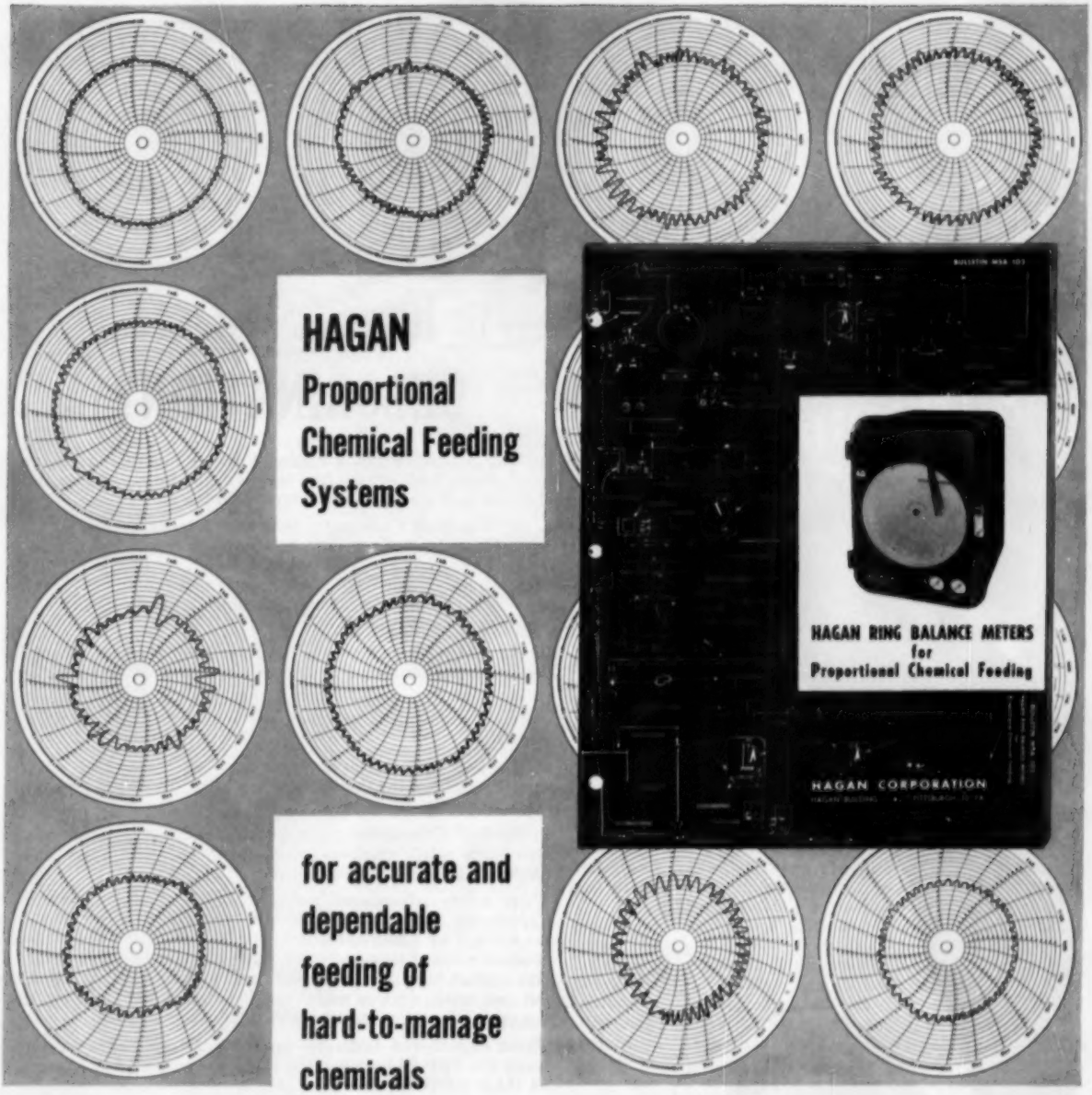
SEMI-RIGID – for use where corrosion is a major problem, including transportation of brine, sour crude, acids, natural gas. Non-toxic; recommended for food processing. Also excellent for electrical raceways.

Now Continental brings you *four* different types of plastic pipe. Our experts are ready and eager to help you pick the kind and size best suited to your purpose. In addition, we are now making the complete line of plastic fittings formerly maufactured by Tenco, Inc., of Winona, Minn. Whether you are handling water, food or drug products, chemicals, sour crude, salt water or natural gas, we can give you the best in plastic pipe and fittings at one call. May we hear from you soon? No obligation, of course.

CONTINENTAL CAN COMPANY

MILLS PLASTIC PIPE DIVISION

SALES OFFICE: 100 East 42nd Street, New York 17, N. Y.
FACTORY: 2930 North Ashland Avenue, Chicago 13, Ill.



Hagan Bulletin No. MSA 102 is a carefully compiled and detailed description of a variety of Proportional Chemical Feeding Systems. Based on successful installations, the bulletin contains not only descriptions and diagrams covering both continuous and intermittent feeding, but also information on the applications for which each system is suited.

The accuracy and dependability of Hagan Ring Balance Systems are a direct result of the unique Ring Balance principle. Hagan Systems are rugged, built to last, and to function reliably with a minimum of operator attention and maintenance.

Wherever a high degree of accuracy and absolute dependability are a must—Hagan Ring Balance Meters are indicated. Write for Bulletin No. MSA 102. If you have a special problem, a Hagan engineer will be glad to discuss it with you.

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA

Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems Control System for Aeronautical and Automotive Testing Facilities

how much does it cost...

to have *Safest*

CHLORINATION?

Nothing—when you buy a Fischer & Porter Chlorinator. That's true because fool-proof safety features are already engineered into this modern, instrument-type chlorinator.

> The F&P Chlorinator is instrument engineered from top to bottom to be absolutely safe in any emergency—and the safety features respond instantly. The mechanical design—without hydraulic devices to introduce time lag—make this a certainty . . .

In the F&P Chlorinator you can take a hammer and shatter the flowmeter tube—and the chlorinator shuts down *instantly*.

In the F&P Chlorinator you can pull the flow setting needle valve right out of its socket—and the chlorinator shuts down *instantly*.

In the F&P Chlorinator you can shut off the ejector water supply while leaving the chlorine on—and the chlorinator shuts down *instantly*.

In the F&P Chlorinator a simple series of hand manipulations tests each safety component—or shows the reason for malfunctioning should it ever occur.

These safety advantages are yours in the Fischer & Porter Chlorinator. They cost you not one penny more at the outset, since the F&P Chlorinator is lower in first cost. They avoid constant costs of repeated safety tests and checks. They assure you against high costs of repairs and maintenance. We don't put our safety devices under a bell jar—they are right out in the open where you can see and touch them.

These engineered features—*instrument-type engineering*—make the F&P Chlorinator the safest ever built. And you get all these safety features *plus* ease of operation, dependability proven in over 600 operating units, complete corrosion resistance—everything you should have in a chlorinator—and you get them for even less cost in the initial purchase. Write today for full information, details on free trial offer, and *absolute guarantee of satisfaction.*

complete process instrumentation

FISCHER & PORTER CO.

135 Fischer Road Hatboro, Pa.

18 YEARS SUCCESSFULLY MANUFACTURING CHLORINE CONTROL EQUIPMENT

HERE'S YOUR SOLUTION

Every grit problem is *different.* Velocities, head loss, hydraulic characteristics of chambers, capacities, grit size and type, and site conditions—all these factors must be considered in designing efficient grit chambers and collector equipment. There is no one standard answer...no one standard design that can be applied to all problems.

That's why so many engineers rely on Chain Belt Company for the answer to their grit-handling problems. For Chain Belt need not rely on a single standard solution. Each application is carefully studied, and from our background of more than 17 years of experience, we recommend the type and size chamber and equipment you need for most efficient results. In the complete range of sizes and types of Rex® Grit Collectors, there is a basic type that can be best adapted to your individual needs...the one best combination of units that will assure maximum results at lowest over-all cost.

So, whether your plant is large or small, do as so many satisfied users have done, take your problem to Chain Belt.

Take Advantage of These Rex Advantages

Rugged Design...designed and built to withstand the corrosive and abrasive operating conditions ... to handle heaviest loads.

Flexibility of Application...grit channels are designed for each specific application...widest selection of types and equipment to fit any range of channel sizes.

Effective Grit Recirculation... material with excessive organics or improperly separated materials can be recirculated through the channel for resettling. The Rex recirculation feature is rapidly being adopted by others...sure proof that adequate grit conditioning is accomplished by recirculation.

Neat Appearance...head shaft housing completely enclosed. Factory sub-assemblies assure proper field alignment and fit... cut costs and increase equipment life.

For help with your problem, see your nearest Rex Sanitation Engineer or write Chain Belt Company, 4610 West Greenfield Avenue, Milwaukee 1, Wisconsin.

CHAIN BELT COMPANY

District Sales Offices in all principal cities

Distributors in all principal cities and abroad

SAVING WATER

is another advantage of

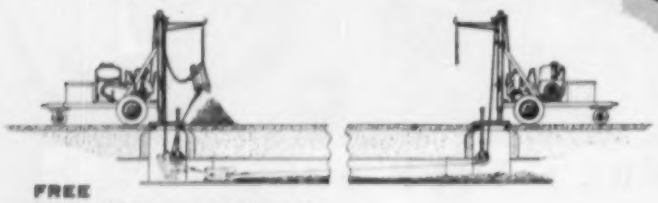
"Flexible"

POWER BUCKET MACHINES

We find cities wasting 1,000 gallons of water a day trying to open a single line with old-fashioned methods. Often they just push the stoppage around.

"Flexibles" require no water—therefore *waste no water.* Furthermore, they remove the stoppage debris "on the spot" —all types.

Saving water may or may not be a problem with your city—but we have many other advantages in "Flexibles" we'd like to tell you about.



FREE DEMONSTRATION INVITED

Flexible SALES CORPORATION

3786 DURANGO AVE., LOS ANGELES 34, CALIF.

(Distributors in Principal Cities)

AMERICA'S LARGEST LINE OF PIPE CLEANING TOOLS AND EQUIPMENT

"Our ROYER has eliminated our last major plant problem"

**name on request*

from an Ohio sewage treatment plant*

This sewage treatment plant had a problem of sludge disposal. The cost of incineration was prohibitive and the sludge could not be disposed of in caked form as fertilizer, even without charge.

In April 1954 they purchased a Royer Sludge Disintegrator and during the first seven months of operation earned 90% of its cost. They are currently selling their entire output of completely shredded, pulverized, trash free, ready-to-use fertilizer at $5.00 per cubic yard. In addition to replacing a cost of disposal with a cash income, they have built up good will with the citizens of their community by supplying an easily handled, useful fertilizer at a moderate cost.

Write for details on this "income producing" equipment. Available in capacities from 1 to 150 cubic yards per hour in electric motor, gasoline engine or belt-to-tractor drives. Turn an "expense" item into a "profit" with a Royer.

ROYER foundry & machine co.

170 PRINGLE ST., KINGSTON, PA.

ROYER

It costs only a few cents per capita per year for the average treatment of raw water with AQUA NUCHAR activated carbon. Today, the public, travelling greater distances and more sensitive to changes in drinking water, is aware of what palatable water means. To be sure of delivering the most palatable water, cutting down on consumer complaints, thorough and effective water treatment can be achieved with the proper dosages of AQUA NUCHAR activated carbon at the right time and place.

only a few cents per capita

AQUA NUCHAR

Industrial Chemical Sales offers you a method of improving the palatability of water. Threshold Odor Experts will, *without obligation*, visit your water plant, assist the operators in the procedures of running Threshold tests, advise as to the efficient amounts necessary and effective points of application of AQUA NUCHAR activated carbon. Furthermore, they will suggest how best to use AQUA NUCHAR in conjunction with other water treatment chemicals. Write today.

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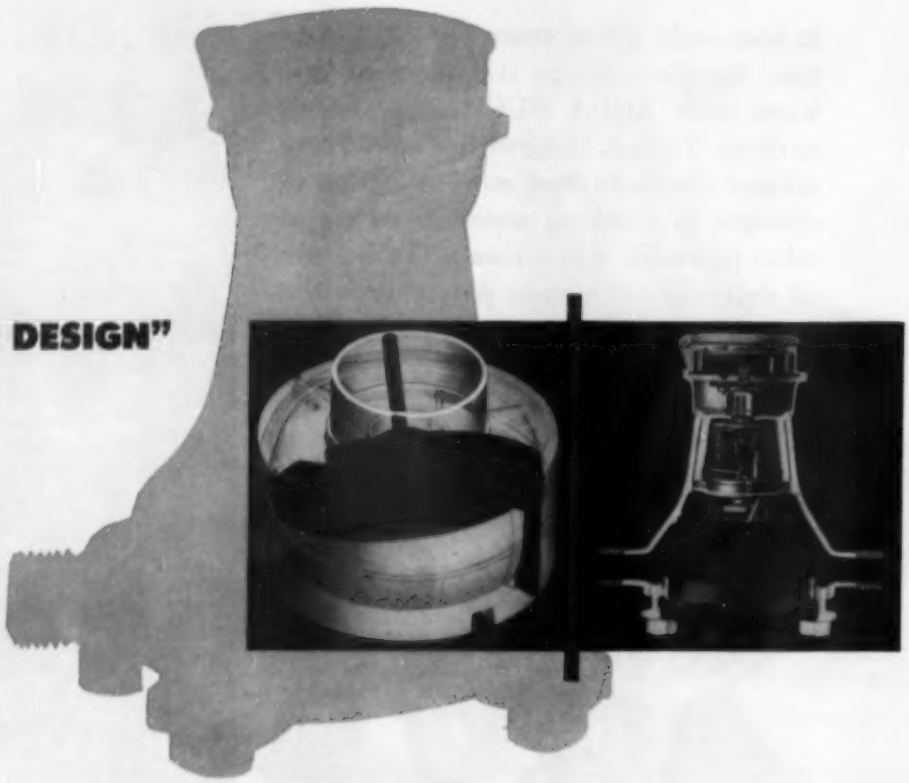
TRIDENT

"BALANCED DESIGN"

MEANS



QUIET, DEPENDABLE OPERATION

Three problems that give meter superintendents gray hairs . . . noisy meters, broken discs and premature failures . . . have as their primary causes turbulence, interference, and improper motion of the disc piston. Here's how Trident meter's "balanced design" eliminates these faults:

The Trident disc is axially controlled. The thrust roller . . . a Neptune "first" . . . guides the disc in the exact path necessary for smooth, balanced flow of the water. No sloppy or eccentric motion to cause noise, disc breakage or excessive wear. Inlet and outlet ports, and the casing itself are carefully designed for smooth, uninterrupted flow of water. There is no turbulence caused by water circulation up through the gear train and stuffing box . . . these are permanently lubricated and sealed from the path of the water.

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WATER & SEWAGE WORKS

VOL. 102, NO. 3 • A Scranton Gillette Publication • MARCH, 1955

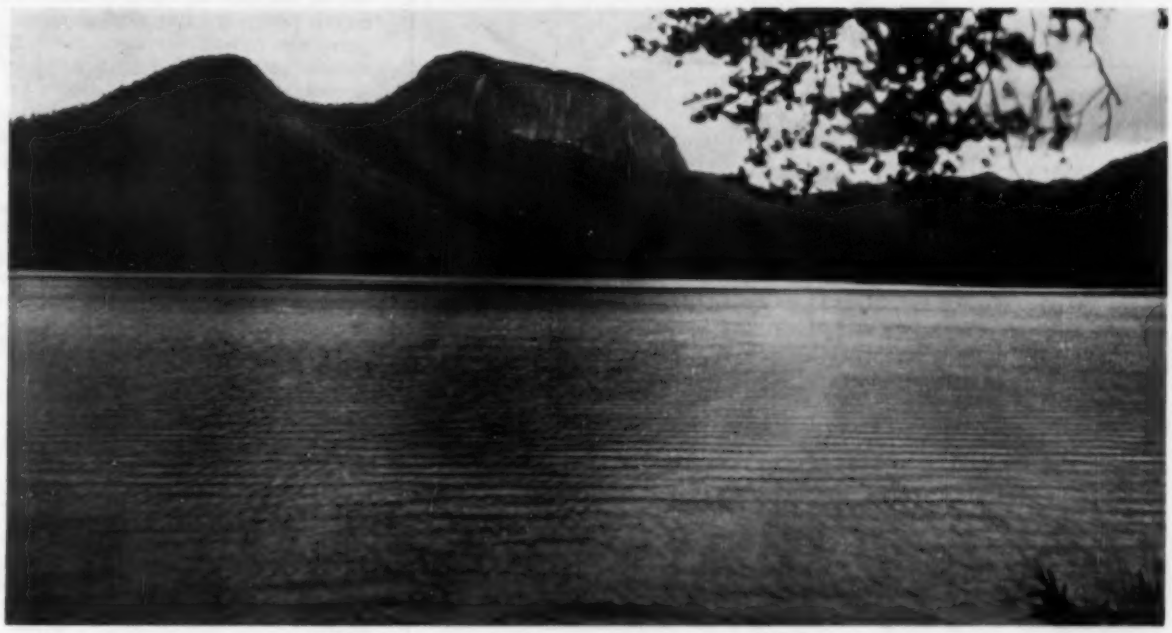

TABLE ROCK—Greenville's mountain reservoir that has paid off.

Pumping Water Downhill

Proves solution to Greenville, South Carolina's water supply problem during protracted dry periods

by ED FARMER

Mr. Farmer is a native Kansan and product of the University of Kansas—1929. For 25 years he has been connected with the engineering firm of Black & Veatch, Kansas City, Mo. The Greenville project is one of a number of important water and sewage projects which he has engineered and supervised.

AS YOU walk down the corridor of one of the leading hotels in Greenville, South Carolina, you cannot help but see a wall-size picture of a beautiful lake. This picture carries the caption "Table Rock Reservoir." The printed matter also calls attention to the fact that this reservoir (see cover picture) is the source of Greenville's water supply from which comes "The World's Purest Water." The drinking glasses furnished in the hotel rooms are wrapped in cellophane, and printed on this wrapping is a statement indicating that this protective covering has been applied to enable you to drink the purest water in the world in its uncontaminated state.

The Superintendent of Water Works at Greenville, as almost everyone knows, is John Hawkins. Mr. Hawkins's extreme modesty is well known throughout the water works fraternity, particularly when he is discussing his own water system, the City of Greenville, and the South in general. We once asked Mr. Hawkins if these assertions that his water supply was the world's purest water were in keeping with his modest nature. His reply was to the effect that many people might consider these statements as a sort of bragging, but he felt he had to go along with them because they were true.

Regardless of whether or not the Greenville water supply is the purest in the world, it is certainly one of the finest water supplies in the country and the growth of the City of Greenville, its industry, and surrounding areas served by this water works has received considerable impetus from the existence of this soft mountain water supply. A typical analysis of this water shows it to have an alka-

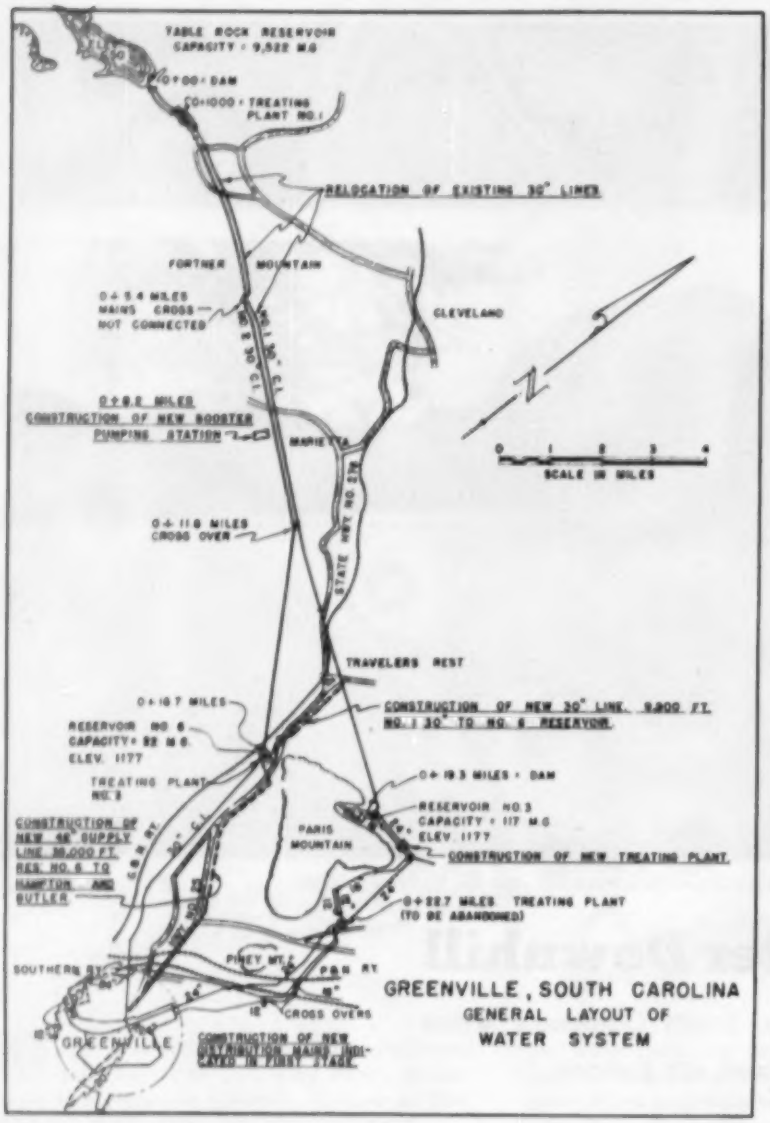
TABLE ROCK RESERVOIR
CAPACITY = 9,522 M.G
10+00 = DAM
CO+1000 = TREATING PLANT NO. 1
RELOCATION OF EXISTING 30" LINES
FORTNER MOUNTAIN
0+5.4 MILES MAINS CROSS — NOT CONNECTED
CLEVELAND
0+9.2 MILES CONSTRUCTION OF NEW BOOSTER PUMPING STATION
MARIETTA
SCALE IN MILES
0+11.0 MILES CROSS OVER
STATE HWY NO 276
TRAVELERS REST
0+16.7 MILES
CONSTRUCTION OF NEW 30" LINE, 9,900 FT. NO. 1 30" TO NO. 6 RESERVOIR
RESERVOIR NO 6 CAPACITY = 52 M.G. ELEV. 1177
TREATING PLANT NO. 2
0+19.3 MILES = DAM
RESERVOIR NO. 3 CAPACITY = 117 M.G ELEV. 1177
CONSTRUCTION OF NEW 48" SUPPLY LINE 30,000 FT. RES. NO. 6 TO HAMPTON AND BUTLER
PARIS MOUNTAIN
CONSTRUCTION OF NEW TREATING PLANT
0+22.7 MILES TREATING PLANT (TO BE ABANDONED)
SOUTHERN RY
PINEY MTN
P & N RY
CROSS OVERS
GREENVILLE
CONSTRUCTION OF NEW DISTRIBUTION MAINS INDICATED IN FIRST STAGE
GREENVILLE, SOUTH CAROLINA
GENERAL LAYOUT OF
WATER SYSTEM

Fig. 1—LAYOUT of Greenville's water system.

linity of 15 ppm; hardness of 1 ppm; total solids of less than 40 ppm.

The City of Greenville is located in the northwestern part of South Carolina in the foothills of the Blue Ridge Mountains. It is the center of a populus industrial and commercial area generally referred to as "Greater Greenville." The metropolitan area served by the Greenville Water Works includes the City of Greenville, several separate political subdivisions, and numerous large industrial establishments, particularly textile mills with their satellite communities. The Greenville metropolitan area, along with other areas in the newly industrialized South, has experienced rapid and continued growth in recent years. The adequacy and excellent quality of the Greenville municipal water supply have been, and will continued to be, major factors in this growth.

Table Rock Reservoir

Table Rock Reservoir and the drainage area supplying it are located in the Blue Ridge Mountains, approximately 25 miles northwest of Greenville. The reservoir (see cover picture) is created by an earth dam on the South Saluda River. The City of Greenville owns the entire water-shed contributory to the reservoir. A portion of the water-shed forms the boundary between North and South Carolina. The drainage area above the reservoir contains about 14½ square miles, all of which are covered with virgin timber. The entire drainage area is patrolled, with human habitation, hunting, fishing, and all other trespassing prohibited. The water leaving the reservoir is chlorinated and treated for corrosion control by the addition of soda ash to maintain a pH value of 8.3; otherwise, no treatment is required. The average rainfall in the drainage area is about 70 inches per year, and during normal years the run-off averages about 35 million gallons per day. Studies of minimum run-off during drought periods indicate a dependable annual yield from the 14½ sq. mile drainage area of about 20 million gallons per day. It is, of course, the drought period yields that determine its ultimate capabilities as a source of supply.

Table Rock Reservoir was built at such an elevation that the water reached Greenville by gravity through originally one and now two 30-inch transmission lines approximately 25 miles long. The difference in elevation, however, between the water level at Table Rock and the distribution reservoirs near Greenville is relatively small and the water followed a rather leisurely course, and the amount delivered to the City through these pipe lines by gravity became inadequate for supplying the ever-increasing demands for this excellent product. In order to hurry things along a little, and perhaps reflecting a little of the Yankee intrusion into the orderly affairs of the gravity supply, it was decided to install "helper pumps" on the transmission line and hence the rather unusual development of "Pumping Water Downhill."

Why Pumping in Preference to an Additional Main?

A review of the relationship between maximum day and average day consumption indicated that when the average day demands reached 20 million gallons, (the dependable capacity of the Table Rock supply) daily demands of approximately 30 million gallons would be encountered during heavy demand periods. It is anticipated that, as the demands approach an annual average of 20 million gallons per day, an additional supply at another location will be developed. Consequently, the current plan of improvements has been designed to provide the most economical facilities for utilizing the dependable yield of the Table Rock supply. The long range planning for the Greenville Water Works indicates the strong probability that an additional supply will be developed on the North Saluda River, and it is expected that this supply will be comparable in na-

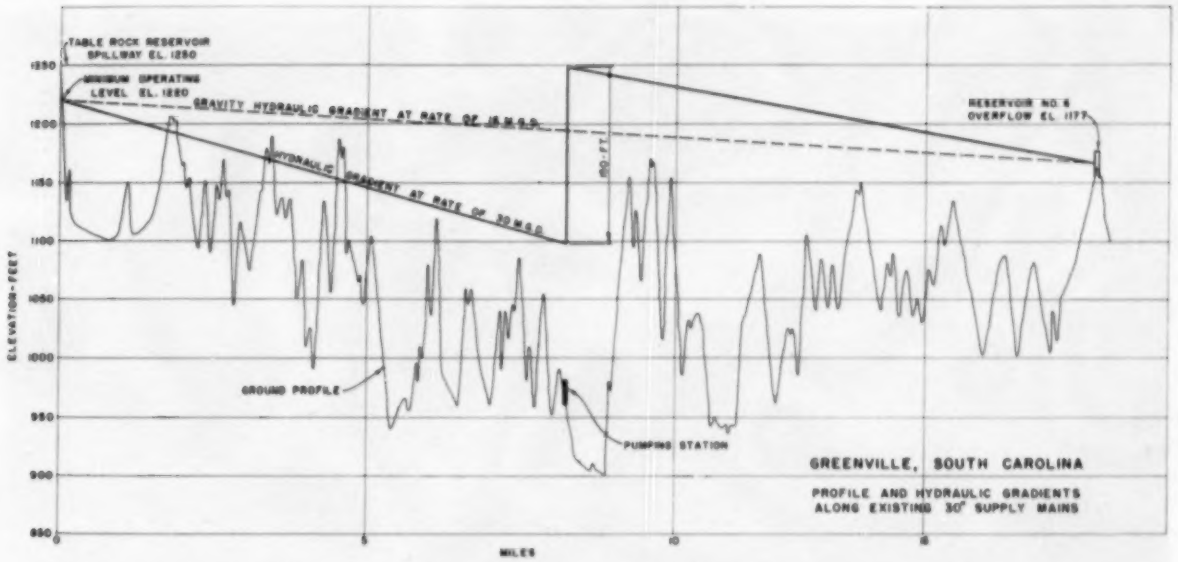

Fig. 2—PROFILE and hydraulic gradient of 19 mile twin 30" transmission mains under gravity flow and downhill pumping.

ture to the Table Rock supply. The demands for water at Greenville are increasing at such a rate that the construction of the new supply must be anticipated within the next few years. When the supplemental supply is made available there will be substantial reserves for future growth, and consequently, neither of the supply sources will be operated at their full capacity for a number of years. The studies for the interim development of the maximum supply from Table Rock indicated that the construction of a booster pumping station at a relatively low initial cost, as compared to some 20 miles of paralleling pipe line, provided a feasible and economical answer, and one that could be financed under existing rates. The fixed charges on the additional investment for a third pipe line would have been considerably higher than the combined fixed charges and seasonal operating costs for the booster station, particularly since the booster station operation will probably be limited to a few summer months for the next few years prior to the construction of the new supply source. Following that construction, the booster station will probably be utilized only in emergencies until the demands reach the stage where the maximum output of the combined facilities is required to meet the larger future demands.

The general location of Table Rock Reservoir and other major elements of the water system, with respect to the City of Greenville, are shown on Figure 1. Prior to the construction of the mountain supply at Table Rock, the City obtained its water from the small impounding reservoir located on he north side of Paris Mountain, shown on Figure 1 as Reservoir No. 3, and from a supplementary filtered supply from the Enoree River. In the early history of Greenville, the entire supply was derived from Paris Mountain and when the growth of the City made this supply inadequate, the filtered supply was added. There was general dissatisfaction with the capacity and the quality of the filtered water source, and in the late 1920's plans were developed and construction started on the mountain supply from Table Rock. At that time, the earth dam forming the reservoir was built and a 30-inch cast iron transmission main constructed from Table Rock to Reservoir No. 3 on Paris Mountain.

Figs. 3 & 4—MAIN LOWERING across ridges to bring high points below hydraulic gradient during all booster pumping conditions.

Fig. 5—DOWNHILL pumping station equipped for two-way radio communication.

Transmission Mains and Equalizing Reservoirs

The spillway elevation of the Table Rock Reservoir is 1250, and the minimum operating level in the reservoir, as determined by the outlet sturcture, is elevation 1220. The spillway on Reservoir No. 3 is at elevation 1177. The length of the gravity flow line between the two reservoirs is slightly over 19 miles, and approximately 7 million gallons could be delivered daily through the original 30-inch transmission main. By the middle 1930's the demands had exceeded the capacity of the first transmission main and at that time a second 30-inch pipe line was constructed from Table Rock Reservoir to the City of Greenville by way of Reservoir No. 6, as indicated on Figure 1. Reservoir No. 6 with a capacity of about 22 million gallons, was constructed as a part of that program. It has a high water level of 1177, the same as Paris Mountain Reservoir No. 3. The transmission mains extending from Reservoir No. 3 and Reservoir No. 6 to the City are connected to the distribution grid and these two equalizing reservoirs float on the distribution system. The transmission mains from these reservoirs must deliver water to the distribution system at the maximum hourly rate of consumption, while the transmission mains from Table Rock to the reservoirs are required to operate at, or somewhat below, the maximum day rate. Due to the relatively large storage capacity in the equalizing reservoirs, daily demands in excess of the maximum capacity of the upper transmission mains can be supplied for a limited period.

At the time the current expansion program was initiated in 1948, the major bottleneck in the system consisted of inadequate distribution mains within the City of Greenville and inadequate transmission lines from the equalizing reservoirs to the City. These inadequacies were most pronounced during peak hour periods. The initial construction was planned to eliminate the distribution system deficiencies and, as expected, the improvement in service within the City and adjacent areas, along with customer growth, resulted in demands that overtaxed the 30-inch line from Reservoir No. 6 and the existing lines from Reservoir No. 3 to the City. The next phase of the construction program involved the installation of a 42-inch main from Reservoir No. 6 to the City. With the installation of this main, paralleling the 30-inch main out of Reservoir No. 6, the bulk of the demands in the City were supplied through these facilities. In order to utilize the full capacity of the transmission mains from Table Rock, a spur connection was constructed from the original Table Rock line to a connection with Reservoir No. 6. Thereby, during heavy demand periods the entire flow from Table Rock is diverted to Reservoir No. 6 and thence to the City through the 30-inch and 42-inch mains. That portion of the demands reaching the City from Reservoir No. 3 was supplied by drawing on the reserve capacity in that reservoir. In such a manner, approximately 16 million gallons per day could be delivered through the transmission mains from Table Rock via Reservoir No. 6. Under the hydraulic conditions which prevailed, from 4 to 7 million gallons per day could be withdrawn from Reservoir No. 3. Since week ends generally permit some replenishment of Reservoir No. 3, the system is capable of supplying between 20 and 22 million gallons maximum day de-

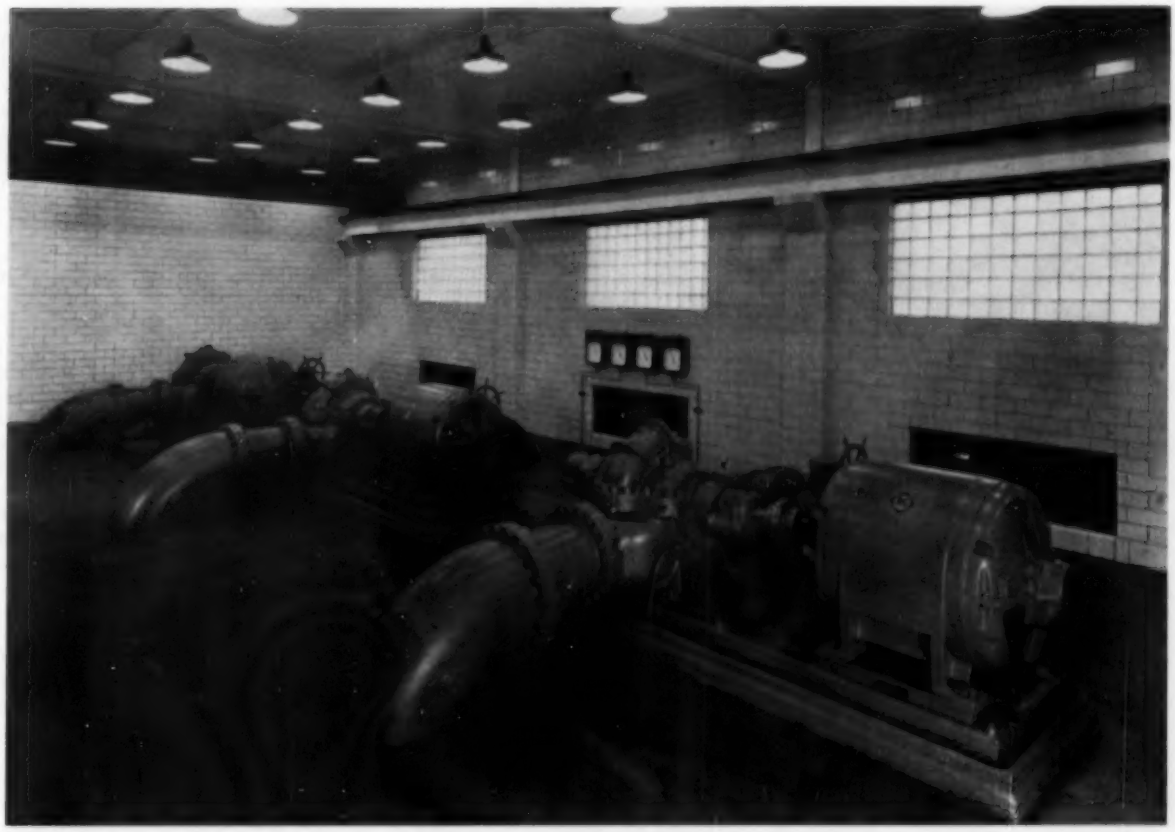

Fig. 5—INTERIOR of pumping station—one pumping unit for each main and a spare.

mands with a transmission capacity (by gravity) out of Table Rock of only 16 million gallons.

"Downhill Pumping"—Next Phase

The next phase of the program involved the construction of the downhill pumping station to increase the transmission capacity from about 16 million gallons per day to about 30 millon gallons per day, depending on relative reservoir levels and on consumption along the route of the transmission mains.

Figure 2 shows a condensed profile of the transmission mains from Table Rock to Reservoir No. 6. The new booster pumping station is located approximately midway between the two reservoirs. This location was selected so that the resulting pressures on the pipe lines would remain within safe limits. The construction of the pumping station at or near the Table Rock Reservoir would have necessitated gradients, and resulting pressures, in some sections of the pipe lines which would have been in excess of the designed strength of the pipe. It will be noted from Figure 2 that the gradient on the upstream side of the pumping station, with pumping rates of 30 million gallons per day, is drawn down to the extent where it is below the original pipe line grade at three points along the profile. In order to maintain all sections of the pipe line under positive head at all times, regardless of conditions of operation, the pipe lines were lowered at these three points. Approximately 1000 feet of each line was relaid at each of the three mountain tops. Service was maintained through one of the two lines while the other was being lowered. In order to maintain the reduction in total carrying capacity, the line being changed was connected to the adjacent line a short distance on each side of the section being lowered so that the entire flow was carried by the single line for only a short distance around the construction operations.

The existing pipe lines are approximately 30 feet apart and due to the necessity of maintaining a reasonable earth cover over the pipe, the mountain tops were cut away in a broad open-cut section approximately 50 feet wide at the base. These open-cut sections were carried to a depth a few feet above the revised grade line and the trenches cut so that the pipe was reinstalled with approximately the same maximum cover as existed before the lines were lowered. The maximum depth of excavations for the open-cut sections was about 40 feet. Figures No. 3 and No. 4 indicate typical excavation and relocation operations at the three points of lowering.

"Downhill Pumping Station"

The downhill pumping station includes three electric motor-driven pumping units. A suction header supplies these three pumps through connections to each of the two transmission mains with corresponding discharge header connections to each of the two mains. A swing check valve was installed between the discharge and suction header connections in each main to prevent circulation of water when the pumps were in operation. Each pumping unit is rated at 15 million gallons per day at 150 feet head. Any of the pumps, or combination thereof, can be utilized with either or both transmission lines. Under normal conditions, two pumping units

Fig. 7—SWITCHBOARD and control panels for the three pumping units.

are operated in conjunction with both transmission mains to deliver approximately 30 million gallons per day. If one of the lines is out of service during an emergency, approximately 15 million gallons can be delivered through the other line by the use of one pump. A single pump, operating in conjunction with both lines, will increase the flow from approximately 16 million gallons under gravity conditions to about 22 million gallons. Comparable discharge can be achieved by operating one pump with one transmission main and allowing the other line to flow by gravity.

Since one of the major items of operating cost is the power demand, or standby charge, and since a large storage volume is available at the lower end of the transmission main, there does not appear to be any practical advantage in operating less than two pumping units through the combined transmission mains.

Actually, the system is allowed to operate wholly by gravity until the demands reach the point where either one or both of the lower reservoirs are pulled down substantially and are not sufficiently replenished during the nighttime periods. The pumping units are then started and operated for a sufficient period of time to restore the lower reservoirs to their maximum level. The pumping station will be unattended with the exception that starting and stopping of pumps is manually controlled. Since there is no condition in which the immediate starting and stopping of the station is necessary, a routine schedule can be developed whereby one of the operating personnel visits the station and starts the units. When the lower reservoirs approach the full level, the operator can return to the station to shut the units down. In the event of a power failure, the pumps are bypassed and the flow will continue on the former gravity basis at a reduced rate.

Surge-Free Pump Operations

Considerable discussion and study was devoted to the problem of surges on the pipe line in connection with the pumping station. Contrary to experience with normal uphill pumping stations, the downhill type of station has a distinct advantage from the surge standpoint. In a normal pumping station, the momentum of the water leaving the check valve upon an abrupt stoppage of the pump creates a situation in which a reverse flow or a return pressure wave often creates excessive surges, and some method of relief must be provided to prevent damage to the piping. In the downhill pumping operation, with piping arrangements as provided at Greenville, the water columns on each side of the pumping station are moving at the same velocity, and upon power failure, only gradual deceleration of each column results from the stoppage on the pump. The main line check valves which isolate the discharge side of the pump station from the suction side of the station, open and the entire water column decelerates to a velocity consistent with gravity flow. Only relatively minor surges are experienced under such conditions. Tests have not yet been carried out to determine the exact surge situation, but during the shakedown period of the station, power failures were experienced with one unit in operation and little or no surge was encountered.

The principal surge, or high pressure condition, which must be controlled is involved in the starting of the pumping units. Immediately prior to starting a pump, the gradient on the suction and discharge side of the station is at the relatively high elevation consistent with gravity operation. If the pump were started without some control upon the discharge from the pump, the initial discharge pressure would approach that resulting from a combination of the high suction gradient plus the approximate shutoff head of the pump. This condition would prevail for a short time until the water column was accelerated, and it is probable that damaging surges or pressures would result. In order to protect against such a situation, a manually operated cone valve was installed in the discharge of each pumping unit. The pump case and the cone valve are designed for pressures consistent with the high suction gradient combined with the shutoff head of the pump. After the pump is started, the cone valve is opened slowly with the operator observing pressure gauges on the suction and discharge headers. In this manner the units are "sneaked on" the line with little or no abnormal pressure disturbances.

Figure 5 is an exterior view of the pumping station along with the electric substation which supplies power from transmission facilities of the Duke Power Company. The station is located in a rather remote spot, and, as stated previously, will be normally

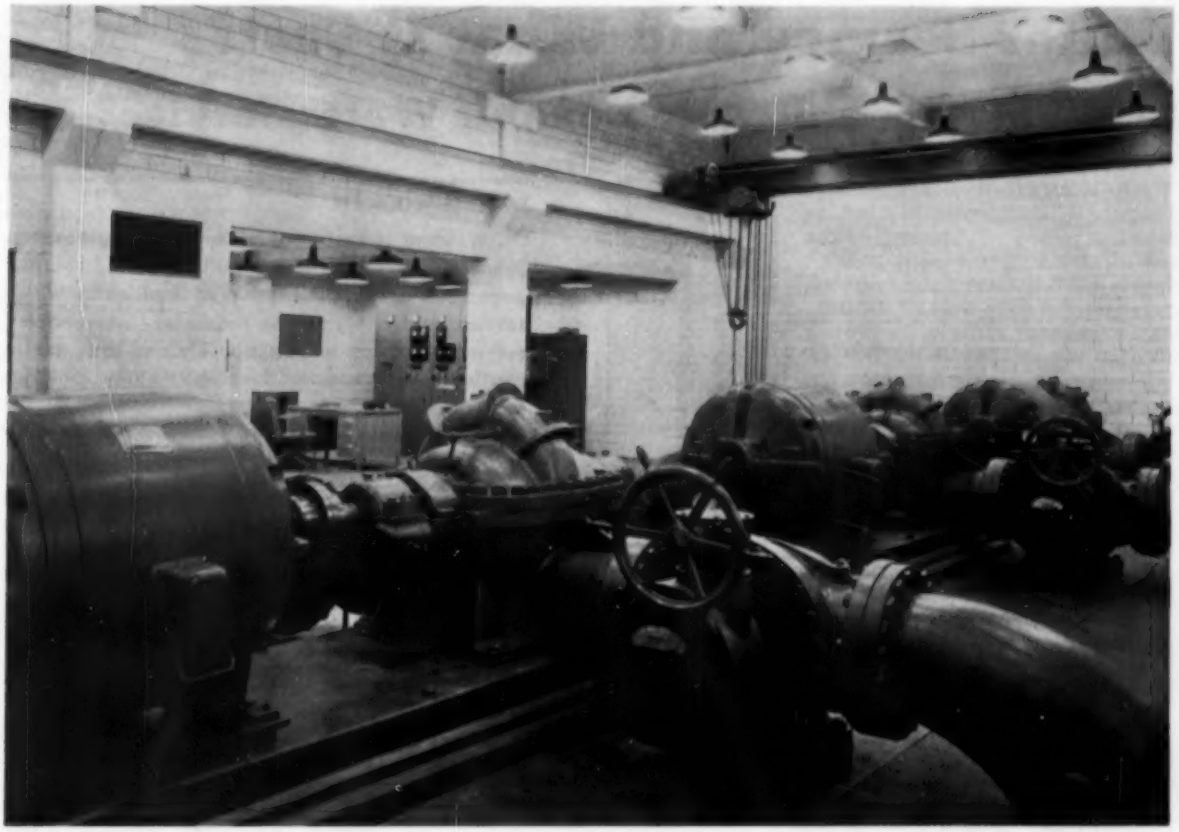

Fig. 8—INTERIOR of pumping station, showing cone-valves manually operated in starting and stopping pumps.

unattended. No windows are provided with the exception of the glass block sections visible in the interior view. Louvers immediately below these glass block openings (Fig. 6), combined with ventilating fans installed in the roof, provide the necessary ventilation and dissipation of heat when the pumps are in operation.

A radio tower can be observed projecting above the roof of this structure. The Water Department at Greenville operates its own radio system, and all of the principal stations and departmental vehicles are equipped with two-way radios. These radio facilities are of great value in operating the widely scattered facilities of the Greenville Water Works, and were a big help in carrying on simultaneous pressure readings during experiments run to determine the probable flow and pressure conditions which would prevail under the expanded plan of operation.

Figure 6 shows the three pumping units and interior of the pumping station. The suction header is in the chase in the immediate foreground. A corresponding discharge pipe chase is located on the opposite side of the pumps. Two pumps develop the capacity of the station and the third pump is a standby unit.

Figure 8 shows the location of the cone valves on the discharge side of the pumping units. As stated, these valves are manually operated while observing pressure gages. The pumps are manually started and stopped by one of the operating personnel of the Water Department whose normal duties are elsewhere. Very little direct labor is required for the operation of the station, although during the initial periods, an attendant was maintained at the station whenever it was in operation.

The total cost of the pumping station was approximately $250,000 and the cost of the pipe line relocations was slightly over $180,000. No detailed estimates were prepared as to the cost of a paralleling pipe line, but it is reasonable to believe that such a line would have cost approximately $3,000,000. The principal operating expense of the pumping station is the cost of electric power. This is expected to run in the neighborhood of $30,000 per year under conditions of seasonal operation of the station anticipated during the next few years.

The design of the downhill pumping station, along with the planning and supervision of construction of other major facilities constructed for the Greenville Water Works during the past several years, has been carried out by the engineering firm Black & Veatch under the joint supervision of E. E. "Spec" Bolls and the author, and the general direction and supervision of John Hawkins, Water Works superintendent.

The administration of the Greenville Municipal Water Works is under the direction of a three-man Board of Commissioners, of which H. C. Beattie is chairman. F. W. Symmes and J. Ed Hart are the other members of the Board. **W&SW**

not sufficiently replenished during

standpoint. In a normal pumping sta-

as stated previously, will be normally

Water Service and What It Costs

1—What Constitutes Reasonable Water Service?

by ABEL WOLMAN

Dr. Wolman is Professor of Sanitary Engineering, Johns Hopkins University, Baltimore, Md. **In this paper he evaluates the causes of inadequate water service, and analyzes the nature of "reasonable" service which can be continuously and consistently available. In conclusion, he takes "a new look" at financing improvements.**

THE WATER WORKS industry in the United States has had an enviable record of accomplishment and of service. These water utilities, largely publicly owned and operated, have invested more than $7,500,000,000 in essential facilities to provide adequate service for 100,000,000 urban consumers. In recent year the water works industry has expended in excess of $400,000,000 a year in new construction. This expenditure, relatively large as it is, however, has not been sufficient, to keep pace with the requirements of the growing population.

In the United States a sharp rise in the use of water since the end of World War II has not been accompanied promptly by increases in the facilities to meet the demands upon them. These deficiencies in sources and in distribution are naturally accentuated when droughts occur during the same periods as increased demand. This was the situation in the summer of 1953, a somewhat dry year, followed in most parts of the United States by an even drier summer in 1954.

The inadequacies of water service encountered in 1953 have been broadly described and diagnosed by the United States Geological Survey in a reconnaissance[1] of the causes of these difficulties during that year. Over a thousand systems reported a shortage, defined by the Survey as a situation in which the system was unable to supply the peak demands of customers and restrictions in the use of water were instituted. These difficulties were not dominantly in the systems supplying small populations. Of the 93 systems serving more than 100,000 people, 35 systems or 38 per cent experienced a shortage.

The Survey disclosed that 51 per cent of those water systems reporting, had shortages because of population growth and increased use; about 34 per cent because of supply failure; and 14 per cent because of the combination of these reasons. In the shortages experienced, 20 per cent were attributable to inadequate distribution facilities.

A parallel survey conducted by the American Water Works Association in 1953 covered some 500 systems, serving populations of 10,000 or more. Sixty-eight per cent of these needed additional treatment and distribution facilities and 27 per cent needed additional sources.

During that same year, some 24 million customers were restricted in the use of water. Again, these restrictions were common to small as well as to large communities.

In 1954, inadequate service was perhaps more extensively experienced than in 1953. These inadequacies prevailed in the midwest, the southeast and the southwest. Difficulties were common to all sizes of communities, and again restrictions in use were common.

GENERALLY the consumer was militantly unhappy with what he considered to be bad planning on the part of the water works practitioners. In the June 25, 1954 issue of the New York World Telegram, for example, George Montgomery, staff writer, opens his discussion of the water supply problem in these words: "The short-sighted planning and the pinch-penny policies of many greater New York water systems have handed the suburban home owner an annual lawn-browning headache that will cost him many millions to wash away." Mr. Montgomery continues by adding "The utilities apparently failed to realize the great interest in gardening—and hence need for water—that would be generated by the move to the country; the fact that the modern home is loaded with water consuming appliances like dish washers and washing machines."

In Baltimore, writers in the letter column of the newspapers were equally uncomplimentary and expressed vehement dissatisfaction with a municipal service that can supply ample water in the winter when it is not needed and insufficient water in the summer when it is most needed.

Bad tempers characterized the deficiency situations in every other part of the United States. Technical explanations for the objectionable nature of water service were not impressive with the general public, because they were not too well understood and in some instances were obviously not persuasive. Bans on sprinkling of lawns and gardens still prevailed in many parts of the United States until the end of September, 1954. In some water systems these bans have been in force every summer for 7 out of the last 10 years.

It is pertinent to point out that the average daily consumption of water, on a sample of some 548 water supply systems in this country, is now about 150 gallons per capita. In 1910 it was 100. This rise should be borne in mind when the difficulties to be overcome are under discussion. Great as this increase has been, it is not nearly as great as the increased service requirements of the individual for a variety of other less important services.

THE SITUATION will not be improved without heroic measures in the immediate future. We cannot look for setting the clock back, in population to be serviced, in water to be used, or in peak requirements for normal demands. By 1960 the people to be served by public water systems will undoubtedly exceed 120,000,000. Legitimate per capita water use will slowly increase even with the best water conservation measures which may be appropriately required.

Since misery loves company it may hearten the water works official in the United States to know that his headaches are more than matched in most of the foreign countries, where public water supply systems are used. In the London Metropolitan area, a vast population is confronted with an increasing water use, a limited series of economical sources and a future

demand for water for some 10 million thirsty customers. Here, too, population growth and increased installation of water consuming devices are pressing the water works official for large expansions.

In Manila, inadequate water service is the subject of almost daily newspaper attack. Competent management has found it impossible to keep pace with the tremendous population growth and the long delay in expansions prior to the Liberation. Source and distribution problems confront this metropolitan area of some one and one-half million customers. Many of the suburban areas are frequently without water, while others are dependent on service only during certain times of the day.

In Tokyo's municipal area, large populations in peripheral sections are under limited or no water service. A new source probably will not be available for two more years. Distribution difficulties are great.

In Hong Kong, perhaps the most acute water shortage situation in the Orient resulted in water service, even in fashionable hotels, being supplied only between the hours of 5:00 p.m. and 9:00 p.m. each day. The business of supplying a City of 2,300,000 people with water in the distribution system for only four hours each day is an enlightening one. New sources are under construction, but probably will not be available until the end of 1956. Here, too, the summer of 1954 was none too helpful in rainfall.

We are confronted therefore with an inadequate water service, definitely unsatisfactory to the average customer, not only in the United States, but on a world wide basis.

Supposed Causes of Inadequate Service

(1) *Wars, depressions, inflation, scarcity of materials and of manpower* have operated to intensify the water service problem in this country. The responsibility for the degree of interference and delay rests with no single group. While such forces have diagnostic values, they are singularly unimpressive to the consumer in 1954. The intelligent customer accepts the explanations as valid, but he looks to a speeding up process in the water works field, as has been demonstrated as feasible in many other industrial enterprises.

(2) *Increased per capita use* has resulted from the development and widespread installation of many devices and improvements in house and commercial living. They cover air conditioning, the increase in lawn sprinkling (due undoubtedly to the great spill into the suburban areas), the advent of the washing machine, of the dish washer, of multiple bathroom facilities, and of individual residence swimming pools. These and other known and unpredictable products of American ingenuity are undoubtedly raising the average and peak water consumer demand.

(3) *Unprecedented industry expansion* requires more and more water for old and for new processes. This demand is likely to continue to increase even with the best of conservation measures.

(4) *Unexpected and unprecedented increases in population* have taken most experts by surprise. Contrary to most opinions, these increases in population have taken place both within the old City and to an even greater extent in the so-called metropolitan rings around the City. To the water works man this population growth, quite unparalleled throughout our history, has supplied one of the major headaches. Although we are informed that the population curve is likely to flatten out in the years to come, we should not rest too optimistically on this hope. The gain from 1950 to 1954 for example, in Connecticut, New Jersey, and New York States in growing suburban areas has been 17.1 per cent. In several of these areas, such as Nassau, Suffolk and Middlesex Counties, the percentage increases in the same four years have been 43.7, 37.4 and 24.6 per cent. No great consolation in any of these figures may be detected for responsible water utility people.

In the water works industry, however, we have tended to assume that we are confronted with an insoluble problem, quite unlike that encountered by any other public service. Although the population of the United States has increased since 1920 by approximately 50 per cent, in the same period the per capita production of energy went up over 500 per cent. By and large, this increased requirement has been favorably met by most of the public power utilities. The amount of water produced has increased perhaps only 100 per cent in the same interval. Our sights need to be greatly lifted. Ernest T. Weir, President of the National Steel Corporation, has recently and pertinently stated as follows: "If we did not have today at least a 50 years' reserve of coal and ore ahead of us, I would not feel very safe." This comment from a leader in a collateral industry is not intended in any fashion to give a criterion for the water works industry. It does, however, represent the kind of thinking which prevails in a major industry responsible for supplying a commodity as rapidly and as regularly as the consumer should demand it.

(5) *Decentralized and metropolitan growth* already are familiar phenomena in American life since 1910. The area and density of populations spilling into the metropolitan fringe have been extended rapidly in the last 10 years. That they are a source of complex water service problem is no surprise, since such areas have not been geared to high standards of water service. It is equally true that no small share of the responsibility for this situation lies in the hands of official and practicing engineers.

(6) *The inertia of the public* in arriving at prompt decisions for the expansion of water works facilities is likewise well known. It has been tacitly assumed that the interval between the conception of a program for meeting immediate necessities and the date for actual initiation of construction should be some 10 to 20 years in average municipal practice.

A Symposium of Papers on Water Service and What it Costs

Dr. Wolman's is the first of four papers comprising a symposium on "Water Service and What it Costs" presented at the Annual Meeting of the Pennsylvania Water Works Association in Atlantic City, N.J., in October, 1954. The remaining three papers listed below will be published in coming issues of WATER & SEWAGE WORKS.

2. **A Completely Adequate Source of Supply**
3. **Completely Adequate Water Treatment**
4. **A Completely Adequate Distribution System**

needed additional treatment and dis- ciency situations in every other part of economical sources and a future

Need such an inertia remain undisturbed and unchallenged? By taking for granted that delays in execution are inevitable, the water works industry virtually sanctions the continuance of an undesirable situation.

(7) *Restrictions on the increases of water rates* have in some instances retarded appropriate expansions when required for the provision of adequate service. It is frequently assumed that such increases in rates would be difficult to accomplish. There are many indications that this is a fear which is not borne out by customer desire or customer acquiescence. In Baltimore City, for example, in 1951 an "across the board" increase in water rates approaching 50 per cent was accepted by the community with virtually no dissent. Similar accomplishments are on record in other communities where appropriate public education had been accomplished.

(8) *Prevailing water works opinion* over the last half a century has perhaps had something to do with the situation in which the industry now finds itself. If there was a philosophy as to water service, it encompassed high efficiency coupled with a perpetual emphasis on curtailment of use. It is true that this policy was always lightly coupled with footnotes that the reductions were pointed primarily at illegitimate or wasteful use. It is difficult to recall a parallel of systematic insistence upon selling less and less of a product.

The power industry, of course, has had to initiate curtailment of use on many occasions, due to roughly the same causes as have confronted the water works group. The power industry, however, did not make a virtue of this necessity. It always considered restriction of use as an undesirable commodity marketing process.

It would be interesting to know how the power consumer would respond to an almost continuous onslaught of suggestions that he use no electricity from 8:00 p.m. to 10:00 a.m. every day during the summer. Or how he might respond if he were deluged with suggestions that one bulb per house would be more desirable than a well lighted establishment. It must be remembered that coal, hydro and even atomic power fuel are limited and are costly. Somehow the practitioners in these and other industries intend to keep service adequate to the requirements and the desires of the paying, consuming public.

Nature of Reasonable Service

In recent years much discussion has filled the technical journals in the search for a definition of reasonable water service. These efforts at definition have ranged from the hope that reasonable water service would mean providing water for all parts of the land for all requirements at all times, to definitions which rest rigidly upon a service of limited character dominated primarily by the inflexibility of existing water rate policies. Neither of these extremes is likely to produce the best values to the customers.

Reasonable water service cannot ordinarily include the dramatic necessities of areas which simply have little or no water resources. It is still true that water shortage may be a characteristic of Death Valley, but it may still not be of overwhelming concern to the day-by-day purveyor of water in other parts of the country. This phase of the problem of water service is very well expressed in the following quotation from a document[2] by De Haven, Gore and Hirshleifer, all of the Rand Corporation:

"As so frequently happens, facts and sober analysis largely dissipate fears. Water is an economic resource, like any other. It will never be 'short' in any absolute sense, since there is always more available—at a price. It is true water stringency may limit growth of an area, but only in the same sense in which the limited availability of any resource may be a check upon growth. If a certain region ceases its expansion relative to the rest of the nation or the world for lack of easily available water, it means only that the natural advantages, of which the availability of water is one example, of that region have been utilized to their economic limit. The situation differs in no essential respect from instances in history in which a period of rapid relative growth of one region or another came to an end as the supply of such resources as land or coal was pressed to its economic limit."

The real problem of reasonable water service occurs, therefore, as the result primarily of artificial restraints, largely man-made. Critchlow has recently summarized[3] these restraints in brief terms in a newspaper interview on June 25, 1954. He pointed out "There is no shortage. In a great many places, the trouble—lack of water due to low pressure—occurs because the mains are too small to meet the big demands of a dry spell." He goes on to suggest that municipal and private systems did not keep pace with the giant growth of the suburbs. They sought cheaper stop-gap solutions with minimum expenditures that were bound to cause increasingly frequent restrictions on use.

Almost every public statement of water main extension policy is prefaced by restrictive language. Negative policies rather than realistic, militant, positive programming have too frequently been the guide.

The water works industry should provide a service which is consistently and continuously available, even at peak demands and in anticipation of the requirements of expanding geographical areas. Such reasonable service must encompass the consumers' requirements for all modern water-using devices, including the growing demand for and interest in the use of water for gardening purposes. Such a specification by no means implies that the industry must accept wasteful uses of water, illegitimate diversions, inadequate payment or unsound development of real estate programs.

Preparation for Reasonable Service

The translation of the above specification of reasonable water service into reality will require an arduous effort along a number of important professional fronts. The kind of service which most water works people would prefer to offer to the consumer, and which complies with the specification noted above, cannot be accomplished without reference to at least some of the following stages. The speed and skill with which these stages are reached and passed will determine when the consumer will be more satisfied with water service than he is today.

(1) *Continuing Technical Review.* The uses of water, the sources required, and the distribution facilities essential for reasonable water service should be under continuing scrutiny. Reviews every 10 or 20 years are too infrequent to meet the demands of the times. It is essential for the industry to scrutinize its problems and its solutions, if not week-by-week, at least year-by-year.

Coupled with these reviews, undoubtedly similar assays of the financial aspects of water service will be required. These issues of financial restraints loom large in most discussions, but they consist so often of alibi rather than of diagnostic significance. It should be remembered, as Howson[4] has recently pointed out, that: (a) all water service is cheap, (b) the difference in cost between mediocre and excellent water service

rarely exceeds a fraction of a cent per capita per day, (c) increased water rates simply enable water works to give better service and (d) the cost of water is now comparatively the lowest ever experienced.

Murdoch[5] has expressed similar views in the following colorful language: "Until water works officials stop thinking and acting like managers of bankrupt bargain basements * * * and begin to adopt the attitudes of successful sellers of quality goods, the public will not understand the worth of water works service."

(2) *Development of Criteria of Adequacy.* Many people in the water works industry have been aware for years that we do not have quantitative criteria of adequate and reasonable water service. This lack of specification which might guide both the public and regulatory agencies, needs to be given thoughtful consideration by professional societies. The Fire Underwriters have done yeoman service, over the years, in supplying virtually the only criteria of adequacy. They would be the first to admit that their specifications are limited in scope. They have served, however, to upgrade the quality of service almost more than any other group.

Utility commissioners and practicing engineers have still to meet this challenge, even though they have in many instances developed qualitative criteria of reasonable service which still remain to be translated into guiding principles of general acceptance.

(3) *Public Relations Programs.* These must be extended and must move from historically negative precepts to future positive development. Properly handled, such programs are of inestimable value to the public. Without them, it is doubtful whether the concepts expressed here and elsewhere will make their way expeditiously with the consumer.

(4) *Costs vs. Income.* This aspect of the problem needs no further underscoring, since it has been discussed and elaborated upon for years. It is axiomatic that no service can be provided without appropriate financial return. No misguided conception should intrude into this discussion that a magic wand can dispense with adequacy of income.

(5) *Machinery for Action in Metropolitan Areas.* One of the greatest gaps in the water works industry is in the failure to provide early and promptly enough for the machinery for engineering, administering and financing water works development. The responsibility for this deficiency rests squarely upon all of us, the consulting engineer, the State agencies, the industry itself and the public. Precedents for the establishment of appropriate units for meeting these problems are extensive. Their introduction into most of the metropolitan areas of the country has faltered over the last quarter of a century, primarily because of the absence of an active program for providing such machinery. The situation will not cure itself. The cure still awaits upon an aroused professional and citizen group.

Without the machinery for prompt action it is difficult to see how the requirements of great population shifts are to be met. The population of Los Angeles County, for example, has shown a net gain of 738,880 since the Federal census of 1950. This net gain in less than four years is about equal to adding Pittsburgh or New Orleans. To service such an area without machinery and at a leisurely pace, would certainly result in chaos.

(6) *A New Look at Financing Water Works Improvements.* In 1921, Morse and Wolman pointed out[6] that capital improvements in water systems involved both public and private benefits. They further emphasized the fact that construction which is of value to all the community, and hence to all taxable property, included reservoirs, pumping stations, treatment works, supply lines, and large distribution mains. The payment for such capital investment both in theory and in practice should not and could not come out of current water rates. If these capital improvements were exclusively financed by water rates only two results were to be anticipated. Either the rates would be excessively high, if appropriate capital expenditures were pursued, or the necessary capital expenditures simply would not be made.

OF THE MAJOR sources of revenue of a water works system, namely general taxation, special assessments and water rates, the third has dominated the historical scene. Many reasons may be summoned up to account for the dominance of the water rate as the only source of revenue for water system construction and operation.

The reliance upon the water rate alone or in conjunction with the front foot assessment was never sound or equitable. The dramatic results of the use of only a single source of revenue are apparent throughout the country. It should not have taken a quarter of a century to show that necessary capital expenditures could not equitably rest only upon water rates. The community significance of a water system has been completely ignored in most rate structures and in most water fiscal programs. The mere presence of a water works in a community is of value to all of the taxable property. That property which will benefit now or in the future from the system should share a reasonable part of the cost of its planned expansion.

Expansion in advance of reasonably anticipated service necessities could be materially smoothed if the areas in which such expansions are required are to be subject to modest property taxation. Only by such means is it probable that the necessities of the area may be anticipated with maximum speed. Pressure for immediate consumption revenue would be materially reduced. Likewise, the number of consumers immediately available to each foot of main would not be the sole criterion for expansion. The identifiable requirements of society would provide the basis for designs as well as for income.

Most present methods of financing water works are restrictive in nature. They do not permit the most realistic and prompt planning, action and financing.

Paul Weir[7] gives pointed expression to the water revenue dilemma in the case of the expansion program proposed for the Atlanta, Georgia, water works. He states in his 1953 Annual Report, as follows:

"Water Revenue Certificates have been used to finance capital improvements, extensions, etc., of the Water Department since 1937. These certificates are funded from current revenue of the Water Department not to exceed 20% of the annual gross water sales.

"This method of financing extensions was more or less adequate when the City of Atlanta was 37 square miles and demands for water service were modest. However, under the Plan of Improvement we now have 128 square miles. A large portion of this area requires extensive water service development. A five year plan of development was authorized costing between one million and two million dollars annually. This program still has three years to run. All funds are obtained from the sale of Water Revenue Certificates. This program has just about committed all available Water Department funds for the next three years.

"If Water Revenue Certificates are

the desires of the paying, consuming public.

considered as a means of financing this program, consideration should be given to the fact that funds will not be available until 1957 and then in quantities of only about $1,000,000.00 annually. This would mean about 6 years would be required to complete this $6,000,000.00 undertaking. This is impractical since funds of more than one million dollars a year are necessary to finance this project and the work should be started at once with the completion date in about three years, if Atlanta is to keep up with the present demand for water service.

"It is recommended that all funding for this project be handled with General Obligation Bonds, since our present Water Revenue Certificates are not available in sufficient volume to handle capital improvements of this nature."

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6. A Plan for Meeting Water Supply and Sewerage Costs. Robert B. Morse and Abel Wolman. *Engineering News-Record*. June 2, 1921. Vol. 86, No. 22.

7. Atlanta, Georgia. Annual Report, Water Works, 1953. Paul Weir, p. 25.

W&SW

R. D. Hoak Chairman A.C.S. Water & Sewage Division

Dr. Richard D. Hoak, senior fellow of the Mellon Institute for Industrial Research, Pittsburgh, Pa., has been elected chairman of the American Chemical Society's Division of Water, Sewage and Sanitation Chemistry for 1955. The retiring chairman is Dr. Thurston E. Larson, head of the chemistry subdivision of the Illinois State Water Survey, Urbana, Ill.

Professor J. Carrell Morris of Harvard University was chosen vice-chairman and Hilding B. Gustafson, chief chemist and director of laboratories of Infilco, Incorporated at Tucson, Ariz., was named secretary. Frederick K. Lindsay of the National Aluminate Corporation, Chicago, was re-elected treasurer.

K. S. Watson Elected Chairman National Industrial Wastes Comm.

Kenneth S. Watson, General Electric Company consultant on water management and waste control, has been named chairman of the National Technical Task Committee on Industrial Wastes.

Formed by authorization of the Surgeon General of the Public Health Service, this group meets annually to discuss progress in water pollution abatement. Watson was elected at the recent two-day meeting of the committee at Michigan State College.

Dr. C. Fred Gurnham of Michigan State College was elected vice-chairman. L. F. Warrick of the Public Health Service was re-elected secretary.

N. J. Thompson Dies

N. J. "Tommy" Thompson, Western Waterworks Sales Manager, Dresser Manufacturing Division, died January 31, 1955, in Tucson, Arizona, after an illness of several weeks, at the age of 56. His home was in Denver, Colorado.

Mr. Thompson was born in Fairview, Kansas. He attended schools there, and moved to Denver to accept a position with Thompson Pipe and Steel Company. After 26 years, several of which were spent as secretary and Sales Manager for the company, Mr. Thompson entered the cattle ranching business at Malta, Colorado.

Joining Dresser early in 1949, Mr. Thompson has worked with waterworks engineers and penstock designers throughout the Western half of the United States. A long-time member of the American Water Works Association, Mr. Thompson participated in many meetings, particularly regional meetings in the Western area.

F. S. Friel Elected President Amer. Inst. Cons. Engrs.

The American Institute of Consulting Engineers has announced election of the following Officers of the Institute for 1955:

President — Francis S. Friel; President, Albright & Friel Inc., Philadelphia, Pa.

Vice-Presidents —Clinton D. Hanover, Jr.; Hardesty & Hanover, and Carlton S. Proctor; Moran, Proctor, Mueser & Rutledge, both of New York City.

Secretary—T. T. McCrosky; (Reappointed), Consulting Engineer, New York City.

Elbert J. Taylor Dies —Philadelphia Water Chief

Elbert J. Taylor, chief of the Philadelphia Water Bureau from 1946 to 1952, and assistant chief engineer for the last three years, died on January 22nd. He was 57 years old.

Mr. Taylor was a director of the American Water Works Assn., a member of the Amer. Soc. of Civil Engrs., and of the Soc. of Professional Engineers.

R. W. Hooker President Of Chlorine Institute

R. W. Hooker, vice president of Hooker Electrochemical Co., Niagara Falls, N. Y., was reelected to his seventh consecutive term as president of The Chlorine Institute Inc. at its annual meeting in New York on January 26. Bert Cremers, vice president of the Michigan Alkali Division of Wyandotte Chemicals Corp. was elected vice president. Robert T. Baldwin was reelected secretary-treasurer.

Mr. Hooker has been associated with the chlorine industry since he joined Hooker in 1922 and is active in many industry and civic affairs. He is a past president of the Compressed Gas Association.

The Chlorine Institute has promoted safety in the packaging, transportation and use of chlorine since 1924. Its 24 members include all of the major chlorine producers in the United States and Canada. In addition there are 15 associate members who manufacture materials for the production, transportation or use of chlorine.

for engineering, administering and are apparent throughout the country. "If Water Revenue Certificates are

Equitable Charges for Fire Protection

Public fire protection costs computed by the "Incremental Cost Method" are substantially lower than costs determined by other methods

by DARRELL A. ROOT and THOMAS R. CAMP

Messrs. Root and Camp are partners, Camp, Dresser & McKee, Consulting Engineers, Boston, Mass. They have evaluated methods generally used for computing the costs of public fire protection services, and have developed a new method for computing charges. Their paper was presented at the 73rd Annual Convention of the New England Water Works Assn., and has been released for publication in *Water & Sewage Works*.

THE PRIMARY requirement of a waterworks system is that it have the capacity to perform its two principal functions; the supply of water for general consumption and the supply of water for fire protection. From the performance of these two functions a water works usually secures its revenue, in the form of charges for the water consumed and charges for the fire protection service afforded. It is obvious that the most equitable method of distributing charges is for the *consumer* to pay for the actual water used for general consumption, and for the *property protected* to pay in addition for fire protection. There is a difficulty, however, in determining what constitutes equitable distribution of charges.

Allocation of Service Costs

During many years in which the subject of fire protection rates has been discussed, we believe there has been general agreement on the principle that each function of the water works system should pay for the cost of providing that function. With this in mind, the various items of expense in the water works budget, such as hydrants, meters, services, etc., can be assigned to the function for which the item is used. For example, hydrants, including their connections and gates, should be assigned to fire-protection charges; services, meters, small distribution mains, and purification works should be assigned to the functions of general consumption. Any other special service, such as private fire protection, should be charged to that service.

The allocation of the cost of remaining parts of the assets of the water works, which are used jointly by fire protection and general consumption, can be made by the following general methods:

(1) public fire protection as an incremental cost,
(2) general service as an incremental cost, and
(3) the capacity-ratio method.

The "capacity-ratio method" assumes that fire protection is of no less importance than general service; it provides for the allocation of costs of a joint nature on the basis of some relation between the capacity required for public fire protection and the capacity required for general service. One division of the joint cost is made on the ratio of the cost of a hypothetical system for fire protection only to the cost of that system plus the cost of a hypothetical system for general service only.

The "general service as an incremental cost method" assumes that fire protection is the primary function of the water supply system, and that only those charges not utilized by fire protection should be assigned to general service.

The "public fire protection as an incremental cost method" is the converse of the general service method; it assumes that public fire protection should be charged only with the incremental cost above the cost required for a general service plant.

The authors are of the opinion that the function of a water supply system is first to provide a safe and adequate supply of water for general consumption and that fire protection is an added benefit supplied by the water works system. On the basis of this premise, we believe the most equitable means of assessing fire protection charges is the method of "public fire protection as an incremental cost."

Studies of "Reasonable Return"

The first paper on fire protection rates published by the A.W.W.A. was that prepared by F .L. Fuller in 1888. Subsequently, many articles and discussions on the same subject have been published by the A.W.W.A. and other organizations. In order to bring some of the previous thinking more clearly into focus, we have summarized what we believe to be the most important ideas on the subject.

Metcalf, Kuichling and Hawley Report

In 1911, Metcalf, Kuichling and Hawley presented the results of a most significant study, titled "Some Fundamental Considerations in the Determination of a Reasonable Return for Public Fire Hydrant Service." This study outlined a method for calculating the income which should be obtained for public fire protection service, and was based on the belief that charges for fire protection should at least equal the cost thereof. In general, their proposed method for prorating costs, between the services of furnishing water for general consumption and the service of supplying water for fire protection, was derived from a comparison of the capacities of the facilities required.

The expense of fire protection service bears no relation to the amount of water used, for while a large part of the water plant is held in readiness for the purpose of fire protection, the use of water for this purpose is relatively small. Metcalf, Kuichling and Hawley reasoned that the best way of allocating charges between consumption and fire protection was on the basis of the capacities required for each service. Finally, it was their opinion that the function of a water plant is first to supply the needs of general consumption and second to provide fire protection; therefore, the determination of the cost of fire protection should be based on the cost of the incremental or additional capacity required in the water system for fire protection.

The results presented in this paper were in the form of several diagrams and curves based on data obtainable at that time. An empirical formula was developed to represent the au-

tary.

New York City.

chlorine.

thor's best opinion of the portion of the fixed capital investments chargeable to fire protection. The authors were aware of the limitations of their formula; they called attention to the fact that their studies were of comparative value only in indicating general tendencies, and that in any individual case a substantial departure would be expected from the normal conditions which they assumed. Their assumption that the cost of a distribution system is proportional to the capacity is in error, and there is no evidence in their paper that the authors were aware of having made this error.

The Metcalf, Kuichling and Hawley formula is:

$$Y = X^{\frac{1.67}{0.91}} - 12.1$$

where Y = the per cent of the total fixed capital chargeable to fire protection and X = the population served by the system in thousands. When this equation is applied, the results will be much too high; because the equation is based on the erroneous assumption that pipeline cost is directly proportional to flow capacity. The magnitude of the error will be demonstrated later in this paper.

1929 Water Works Practice Manual

The Water Works Practice Manual of 1929 outlined in considerable detail a method for determining reasonable charges for the fire protection service provided by public water supplies. The fundamental basis of the method was that the charge should equal the cost of the service. In applying the method it was assumed that the first cost of a distribution system is proportional to flow capacity. The proportional cost of fire protection capacity is taken as the ratio between the required fire flows and the sum of the required fire flows and maximum daily demand.

In outlining the proposed method, no assumptions were made as to the water consumption that could be expected for any average water works system. For determining the required fire flows, the Manual recommended the National Board of Fire Underwriters' Standards or other standards which appear most reasonable for the case under consideration. To determine the charges for fire protection service due to fixed costs, depreciation, taxes, maintenance and repair, the Manual recommended that the capacity ratio be applied directly to the expenses in those portions of the water works system which are used jointly for the supply of water for general consumption and for fire protection. The expenses of the portions of the system which are not used jointly, such as the hydrants used only for fire protection purposes and the very small distribution piping which has no real value in fire protection, should be charged directly to that service to which they belong.

1951 Joint Report of Committees

"Fundamental Considerations in Rates and Rate Structures for Water and Sewage Works," is the title of a Joint Report of Committees of the American Society of Civil Engineers and of the Section of Municipal Law of the American Bar Association, published in 1951; it contains a discussion of the problems of allocation of costs of public fire protection. The Committee's approach to fundamentals involved in the problem of determining basic rates for public fire protection service was based on the following considerations:

1. The rates charged for fire protection should be equal to the cost of that service;

2. The quantity of water used does not represent a fair basis for the allocation of fire protection costs;

3. A major element in the cost of water is created by the necessity of being ready to serve, and these costs do not vary with the quantity of water actually used;

4. The most equitable method by which the cost of fire protection service can be determined is by the "Capacity-Ratio Method."

In the "Capacity-Ratio Method," the allocation of all costs of a joint nature is made on the basis of a ratio between the capacity required for fire protection only and the capacity required for fire protection only plus the capacity required for general service.

Discussing the various possible methods by which the cost of fire protection service could be determined, the Committee stated that there should be a direct assignment of certain items which are used for one purpose or another and not jointly, for fire protection and for general consumption. Special fire mains, fire hydrants and appurtenant structures should be assigned directly to the cost of fire protection. Meters, services, purification works and small distribution mains are assigned mainly to the cost of functions other than public fire protection.

The method preferred by the Joint Group is the "Capacity-Ratio Method," which is based on the opinion that neither general use nor fire protection use is more important. One approach to determination of relative capacity involves estimation of the cost of two systems. One system would provide only fire protection and the other would provide only the works required for general consumption. The relative charge to fire protection can then be determined as the ratio of the cost of the system for fire protection only to the sum of the cost of the fire protection system and the cost of the system for general service only.

The Joint Group believed that a less cumbersome and more flexible basis for application of the Capacity-Ratio principle involves the use of flow capacities based on the ratio instead of the costs of the systems. Since the Joint Group believed that this method is the most fair and reasonable means of allocating the joint costs, it is dealt with in some detail in their report.

1954 AWWA Committee Report

The report of the Committee on Determination of Water Rate Schedules was published in the March, 1954, issue of the American Water Works Association Journal. It states in part:

". . . Although most water works managers and engineers have generally accepted the propriety of charging for public fire protection, and courts and commissions have usually included allowances for this service in rate structures, such a charge is lacking in most municipally controlled water works. Privately owned properties usually charge for fire protection, but frequently in nominal amounts.

"Among the factors that have contributed to this state of affairs are: (1) a general feeling that the theories of computing the fire charge have overemphasized the cost of this service; and (2) the fact that a fire charge has been an additional item in a tax budget which is already inadequate for other municipal needs. Under such circumstances, if one hopes to effect any improvement in a confused situation, a more realistic approach is required, both in the method of computing the fire charge and in the manner of its collection.

"In computing the charge, one should accept the premise that the prime function of the average municipal water works today is to supply a commodity, and that fire protection, although important to the safety of the community, is a supplementary service, the charge for which should not exceed the demonstrable additional costs involved in rendering this service.

"The direct additional costs include: (1) the fixed and operating

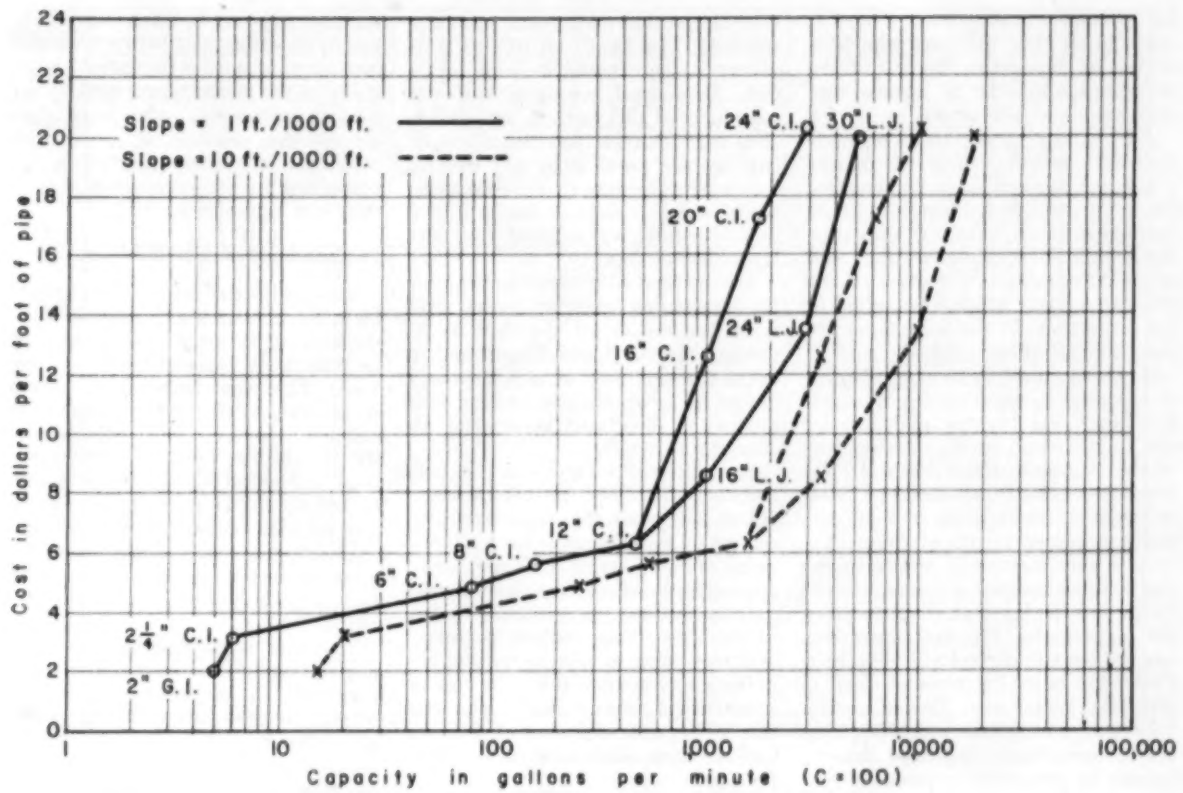

Fig. 1—DISTRIBUTION MAINS. Graphical relationship of cost to capacity.

charges arising out of all plant and equipment installed solely for fire protection, such as hydrants and their connections, and any pumps, mains, storage, or other equipment used only for fire service; and (2) the cost, at normal commodity rates, of the water used in fighting fires.

"The determination of indirect costs —those costs that arise out of the additional plant capacity required for fire protection—has been a difficult hurdle in the past. The mechanics of this determination, particularly as applied to distribution facilities, have been complicated even more by the improved definition of fire demands . . ."

". . . The additional cost of distribution facilities may account for much of the cost of fire protection. An accurate determination would require cost estimates based on two systems —one for fire only and a second capable of meeting the combined demands of fire and general service. Although such estimates could be made by commissions and larger cities, with the aid of rate specialists, it appears that most determinations have been made without such analyses . . ."

This report also presents an alternative approach to the fire protection charge, involving the assumption that storage may be provided in lieu of capacity, and describes a method for calculating the charge based on this assumption.

Discussion of Previous Studies

Perhaps the most noteworthy feature of the Metcalf, Kuichling and Hawley paper is the fundamental idea on which the authors base their reasoning: that the charge for fire protection should be an incremental or extra charge above the charge of supplying water for general consumption. To the best of our knowledge, their idea was not questioned in the wide discussion which followed presentation of the paper. This concept appears to have been adopted by the water works industry, by Public Utility Commissions and Underwriters, and not until much later was doubt raised as to its validity.

The fundamental ideas represented by recommendations in the Manual of Water Works Practice are as follows: that the charges for fire protection service should be equal or related to the cost thereof; that for any water works system, construction cost is directly proportional to capacity; and that the allocation of cost between the two services, that is, fire protection and general consumption, should be in proportion to the ratio of the flows required for each service. It should be noted that the Manual made no effort to formulate the cost of fire protection service for an average water works system but, instead, recommended the procedures to follow and employed the data which are usually available for most water-supply systems.

Several of the basic considerations reported by the Joint Committee should be particularly noted. The opinion of the Joint Committee that the consideration of the cost of fire protection as an incremental cost is not a fair and equitable practice seems unjustified. Much of the difficulty in obtaining equitable rates for fire protection service originated in the negotiations leading to the establishment of water works companies. The demand for water service was so strong that the consumers seldom made an effort to see that a just charge for fire protection service was distributed among the taxpaying population. As a result, many charges for fire protection service are much lower than the cost of furnishing that service. The older water works systems of this country were established for the primary purpose of furnishing water

tection. The expenses of the portions

capacity involves estimation of the

clude: (1) the fixed and operating

for general consumption. Thus, it would seem that the most equitable method of considering the cost of fire protection would be to assume that such costs are incremental.

An analysis of the three methods described by the Joint Committee ("General Service as an Incremental Cost," "Public Fire Protection as an Incremental Cost," and the "Capacity-Ratio Method") shows that there will be no differences in the share of the undivided fixed assets chargeable to fire protection—if the same flows are used for all three methods, and if costs are assumed to be in proportion to capacity, as was done by Metcalf, Kuichling and Hawley and also by the Joint Group in its development of the "Capacity-Ratio Method." If, however, costs are not assumed to be proportional to capacity and are actually estimated for the alternate systems in each method, it will be found that the first method ("General Service as an Incremental Cost"), gives the highest cost for fire protection, and the second method ("Public Fire Protection as an Incremental Cost"), gives the lowest cost. This is a very important conclusion which appears not to have been recognized before; failure to recognize it probably has accounted for much of the confusion in thinking about equitable charges for fire protection.

Distribution System Costs vs. Capacity

At this point it becomes necessary to demonstrate that the cost of distribution mains is not proportional to their capacity, and that substantial errors result if cost is assumed proportional to capacity. The actual cost of distribution mains, per foot of length, constructed during 1950-'52 in the system of a large New England community has been plotted in Fig. 1 against capacity for hydraulic slopes of 1 and 10 ft. per 1000 ft. It will be noted that the actual cost varies at a rate considerably less than direct proportionality. For example, to double the capacity of a 6-inch pipe the cost is increased only 16 per cent (from $4.86 to $5.62 per ft.). Similarly a 2.86-fold increase in capacity is obtained in changing from 16-inch to 24-inch Lock Joint pipe, at an increase in cost of only 58 per cent.

The 1954 A.W.W.A. Committee report states that an accurate determination of the incremental cost of a distribution system chargeable to fire protection would require cost estimates based on two systems, one for fire only and the second with capacity both for fire and general service. Before accurate cost estimates could be prepared, a preliminary design of at least one of the two systems would be required. The high cost of this procedure has prevented its wide adoption. In general, we agree with the soundness of this method, but we believe that accurate determinations of cost are not possible by any method —primarily because of uncertainty as to the weight courts of law will give to calculations of original cost and reproduction cost.

The method of computing fire protection charges developed by our firm is an application of the A.W.W.A. method described above, modified to avoid the necessity of a preliminary design of a hypothetical system. Our method is illustrated hereinafter by a typical example.

An alternative approach is suggested by the 1954 A.W.W.A. Committee, to avoid the expensive procedure of making accurate cost estimates of two systems. This alternative approach involves the assumption that storage may be provided in lieu of capacity. This method is purely arbitrary, and in our judgment has nothing to recommend it. The cost of hypothetical storage bears no relation to the additional cost of a distribution system required to furnish public fire protection.

In its example, illustrating this alternative approach, the Committee adds to the cost of the hypothetical distribution storage the difference in cost of the distribution main based upon a 4-inch differential in pipe size. It is difficult to understand the reason for this procedure. It would seem either that the cost of the hypothetical distribution storage or the cost of the additional main capacity might be used, but not both. The adoption of a 4-inch differential in pipe size, to estimate the additional cost of the distribution mains for fire protection, is purely arbitrary.

The method used by our firm to estimate the difference in the cost of the two systems is based upon a differential in pipe size computed rationally from the flow requirements. As will be shown later, our figures indicate that a 4-inch differential is too great. In addition, our studies show that in large cities the differential should not be charged to large distribution arteries, because the capacity requirement for peak hourly flow will exceed the capacity requirement for fire flow plus maximum daily flow.

Determination of Rates

In our consideration of the cost of furnishing public fire protection for a city with a population of 12,000, supplied by a private water company, the first step was to select methods to use in allocating cost between general consumption and fire protection. After study of the methods proposed by the various authorities who have considered this problem, it is our firm conviction that computing public fire protection as an incremental cost is the most equitable method.

Fundamental Principles Involved

In establishing rates to be charged by public utilities, the Smyth vs. Ames decision of the U. S. Supreme Court in 1898 is the basis of the law of the land. The legal principle set forth in this case is that utility owners are entitled to a fair rate of return upon the present fair value of the property used and useful in rendering the public service. In determining fair values, this decision maintained that all factors affecting fair values must be given the weight due in each case. The following is quoted from this decision:

"In order to ascertain the fair value, original cost of construction, amount expended in permanent improvements, the amount and market value of its bonds and stocks, the present as compared with the original cost of construction, the probable earning capacity of the property under particular rates prescribed by statute, and the sum required to meet operating expenses, are all matters for consideration and are to be given such weight as may be just and right in each case. We do not say that there may not be other matters to be regarded in estimating the value of the property. But the company is entitled to ask a fair return upon the value of that which it employs for the public convenience. On the other hand, what the public is entitled to demand is that no more be exacted from it for the use of a public facility than the services rendered by it are reasonably worth."

The two limiting methods for determining fair value of property involved are: (1) the actual legitimate cost of the utility's property less depreciation, and (2) the present-day reproduction cost less the depreciation values based on the reproduction cost. There has been much controversy concerning relative weight which should be given to each of the above limits, in arriving at fair value of property under consideration.

In the example which follows, we have used both these limiting conditions to estimate the cost of fire protection. The rate for fire protection established under these assumptions is for public fire protection. The cost is directly assignable to the taxpayers

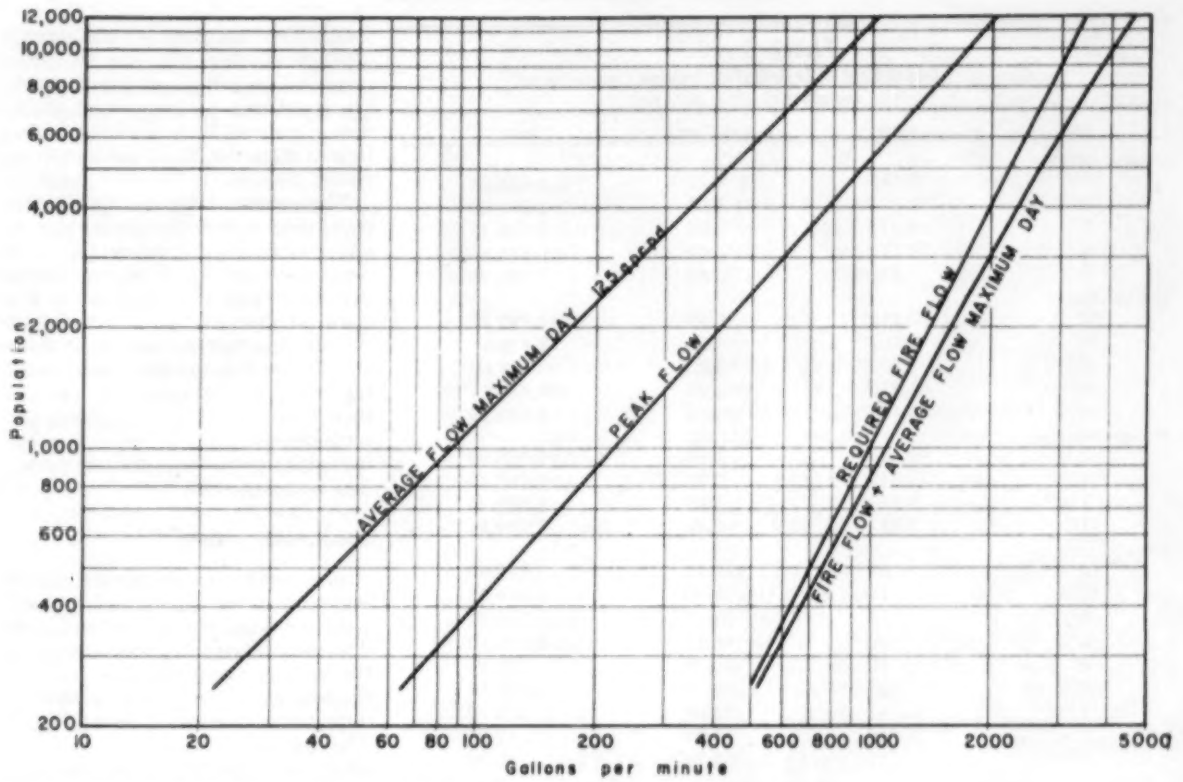

Fig. 2—MUNICIPAL WATER REQUIREMENT. Estimated present flows in terms of population served.

of the city served by the water company; it is most feasibly charged directly to the city and paid for by the city. The cost is distributed to the taxpayers of the city by the normal taxing procedures.

Computations for Determining Rates

In this study, basic data used for making computations by the "Incremental Method" were obtained from the records of the water company. The water consumption data were taken from the company's daily meter readings. The maximum daily consumption during the past three years was as follows:

July 10, 1952.....1,470,000 gal.
July 8, 1951.....1,400,000 gal.
July 11, 1950.....1,446,000 gal.

For this study a maximum daily consumption of 1.5 mgd (million gallons per day) was used. No records were available of the peak consumption; this was estimated at 3 mgd, or approximately twice the average consumption on the maximum day.

In plotting the curves shown in Fig. 2 for maximum daily and peak domestic flows, the ratio of the peak flow to the average flow on the maximum day, was assumed to vary from about three for small populations to about two for large populations.

In estimating maximum fire flows, we have used the requirements of the National Board of Fire Underwriters as represented by the formula $Q = \sqrt{x}\,(1\text{-}0.01\sqrt{x})$ where Q is in gpm (gallons per minute) and x is the population in thousands. In instances where the fire requirements, as established in conformity with the National Board of Fire Underwriters' Bulletin No. 266, are different from those given by the formula, the actual requirements—correlated with the population of the city and portions thereof—should be used instead of the requirements given by the formula.

In our study we have assumed that the capacity of the existing distribution system is equal to the requirements of the National Board of Fire Underwriters; that is, that fire flows represented by the formula are available concurrently with a general demand equal to the maximum daily consumption. If the existing distribution system does not meet these requirements, it is not necessary to adjust the computations to reflect the deficiencies of the system. Since the result sought is the incremental cost of fire protection and this increment is obtained by deductions from the

TABLE 1
Sizes of Pipe Required
Hypothetical System Supplying Domestic Consumption Only

Population of Community	Q_2/Q_1 Peak Fire + Max. Day	$(Q_2/Q_1)^{\frac{1}{2.46}}$	Sizes in Present System							
			6"		8"		10"		12"	
			Req.	Use	Req.	Use	Req.	Use	Req.	Use
250	0.128	0.458	2.74	3						
500	0.161	0.500	3.00	3						
750	0.186	0.528	3.17	3	4.23	4				
1,000	0.208	0.551	3.31	4	4.40	6	5.51	6		
2,000	0.263	0.602			4.81	6	6.02	6	7.22	8
5,000	0.358	0.676					6.76	8	8.11	8
8,000	0.414	0.715							8.58	10
10,000	0.436	0.729								
12,000	0.470	0.750								
			Use 3"		Use 6"		Use 6"		Use 8"	

TABLE 2
Initial Cost of Distribution System
December 31, 1952

Size	Units	Unit Cost	Total
Cement-Lined Pipe			
12"	2,682'	$ 1.30	$ 3,486.60
10"	2,271'	1.00	2,271.00
8"	4,019'	0.85	3,416.15
6"	27,272'	0.72	19,635.84
4"	446'	0.65	289.90
Cast Iron Pipe			
12"	30,339'	6.99	211,999.35
10"	7,763'	4.91	38,116.61
8"	8,903'	3.95	35,139.07
6"	62,216'	2.33	144,664.01
4"	5,137'	1.16	5,939.59
Wrought Iron Pipe			
2"	44,413'	1.89	83,968.59
1½"	18,315'	0.72	13,160.38
1¼"	5,513'	1.03	5,662.71
1"	1,621'	0.94	1,519.31
Gates			
12"	67	112.33	7,525.90
10"	13	78.00	1,014.02
8"	23	68.11	1,566.57
6"	180	46.47	8,365.10
4"	10	20.56	205.55
2"	102	19.15	1,953.46
1½"	42	12.04	505.72
1¼"	16	13.27	212.24
1"	11	6.71	73.76
		Total December 31, 1952	— $590,691.43

existing system, the increment will not be substantially changed by adjustments to reflect the inadequacies of the existing system.

In determining the per cent of the total value of the distribution system chargeable to fire flow, it is necessary to compare the cost of the existing system with the cost of a hypothetical system having no fire flow capacity. The standards of the N.B.F.U., which in our opinion are reasonable, require that the system be capable of delivering an adequate fire flow simultaneously with a normal draft equal to the maximum daily demand. We see no reason for assuming that the maximum fire flows will occur simultaneously with peak demand as has been assumed in some studies of this problem. Regardless of whether or not fire flow capacity is provided, a well-designed water works system must be capable of delivering a flow equal to the peak draft or peak hourly demand to be expected during the year.

In comparing the existing distribution system consisting of pipes 6-in. and larger (pipes smaller than 6-in. are not adequate for fire protection and were assigned only to the distribution of domestic supply) against a hypothetical system for general service only, we have assumed that the latter system requires capacities adequate to supply peak demands. In other words, we believe that the capacity in the system chargeable to fire protection is equal to the maximum daily demand plus the maximum fire flows minus the peak demands.

As an example: for a population of 250, the fire flow plus the maximum daily flow (see Fig. 2), is 520 gpm, and the peak flow is 65 gpm. The difference of 455 gpm, 87.5 per cent of the total, is chargeable to public fire protection. Similarly: for a population of 12,000, the fire flow plus maximum daily demand is 4,500 gpm and the peak flow is 2,080 gpm. The difference of 2,420, 53.8 per cent of the total, is chargeable to public fire protection. These additional capacities, large as they are, are to be charged for on the basis of the additional cost of the pipes.

The sizes of pipes required in the distribution system, for the hypothetical case of supplying domestic consumption only, were obtained by using the Hazen & Williams expression for flow in pipes. With any given hydraulic gradient and friction factor, the flow is proportional to the 2.63-power of the diameter, thus:

$$Q_2 = Q_1 \times (D_2/D_1)^{2.63}$$

From this formula a hypothetical pipe of diameter D_2 can be determined which will give a flow capacity, Q_2, equal to a given per cent of the flow capacity, Q_1, in a corresponding pipe of diameter, D_1 in the actual system.

The values of Q_2 and Q_1 for any population within the system may be taken from Fig. 1, where Q_2 is the peak flow and Q_1 is the maximum daily flow plus the fire flow. If it is assumed that any given pipe in the distribution system, 6 inches in diameter or larger, is adequate for providing fire flows plus maximum demand, then from Fig. 2 and the above formula the diamenter of the corresponding pipe in the hypothetical system may be computed.

Computation of Data

The results of computations as described above are presented in Table 1 for populations from 250 to 12,000. The ratios Q_2/Q_1 of peak demand to the sum of maximum daily and fire demand as shown in the second column were determined from Fig. 2. The headings of the last four columns show the pipe sizes in the existing system. Under each size of existing pipe and opposite a given population are two columns. The first column shows the theoretical pipe sizes required to supply peak flows only as computed from the equation. The second column shows the nearest standard pipe size sufficient to provide the peak flow only. This is a reasonable consideration, since in the final cost analysis it is reasonable to use only available pipe sizes. The pipe sizes for the hypothetical system have been computed only for populations which may reasonably be served by existings sizes at the head of each column. These limitations were determined by a study of the distribution system in question.

It will be noted from Table 1 that most of the existing 6-inch pipe would be replaced by 3-inch to produce the hypothetical system; most of the 8-inch by 6-inch; most of the 10-inch by 6-inch; and most of the 12-inch by 8-inch. In our computations to determine the cost of the hypothetical system, we have used the above replacement sizes. The sizes used are indicated at the botton of Table 1.

Table 2 gives the length, size and original cost of the distribution mains as of December 31, 1952. These figures are available in the records of most private water utilities, and should be available for a publicly owned water works.

The estimated difference in cost of

a hypothetical system, which is capable of delivering the peak demand on the maximum day for domestic consumption only, and the actual system is given in Table 3. The sizes were obtained from Table 1 and the costs for those sizes were obtained from Table 2. Table 3 shows an incremental cost of the distribution system for fire protection of $211,866 based on original cost which is equivalent to 35.87 per cent of the total cost of the distribution system. This figure has been used to allocate the distribution system value as shown in Table 4.

TABLE 3

Incremental Cost of Distribution System for Fire Protection

Calculations based on Tables 1 and 2

Size	Price	Present System Length	Cost	Domestic Only Length	Cost
	Cement Pipe				
12"	$ 1.30 per ft	2,682 ft	$ 3,487		
10"	1.00	2,271	2,271		
8"	0.85	4,019	3,416	2,682 ft	$ 2,280
6"	0.72	27,272	19,636	6,290	4,529
4"	0.65				
3"	0.65*			27,272	17,727
	Cast Iron				
12"	6.99 per ft	30,339 ft	211,999		
10"	4.91	7,763	38,117		
8"	3.95	8,903	35,139	30,339 ft	119,839
6"	2.33	62,216	144,644	16,666	38,832
4"	1.16				
3"	1.16*			62,216	72,171
	Gates	Number		Number	
12"	112.33 each	67	7,526		
10"	78.00	13	1,014		
8"	68.11	23	1,567	67	4,563
6"	46.47	180	8,365	36	1,673
4"	20.56				
3"	20.56*			180	3,701
			$477,181		$265,315
			265,315		
	Incremental Cost for Fire Protection		$211,866		

*Prices for 3" hypothetical sizes assumed to be the same as the prices for existing 4" sizes.

Fixed Assets of System

The fixed assets of the water works were taken from figures prepared by the management. These are shown in Table 4. The allocation of these fixed assets is based upon the principle of incremental charges for fire service. In conformance with this principle, such items as the pumping station, electric pumps, transmission main, and reservoir were determined to be required by a system which would supply domestic consumption only under methods of operation now employed by the water works.

For example, one electric pump operating for approximately 10 hours will produce 1.5 mgd or approximately the maximum demand of the present consumers. Since pumping is done only during off-peak hours and is limited to approximately 10 hours, it was deemed necessary that a pump of this size would be required for domestic service only. The second pump would also be required for standby purposes. The 14-inch transmission main was found necessary to deliver deliver this quantity of water to the reservoir. The items applicable to fire protection only are hydrants, fire-service conections, the new elevated tank and the transmission main to the elevated tank, land for the elevated tank and the fire-protection share of the undistributed items.

Allocation to Three Classifications

The fixed assets, listed in Table 4 are allocated to three different classifications; namely, General Service, Fire and Undistributed. The assets allocated to Fire are those items used only in fire protection and are the new elevated tank, hydrants, and similar items. Certain items of fixed assets are not easily assignable to any classifications and are allocated to Undistributed. Such items are used in part by the other three classifications and consist of general equipment, miscellaneous property, buildings, etc.

After the assets are assigned to these various classifications they are totalled and the undistributed total is distributed between General Service and Fire in direct ratio of the total of each of these items to the total of these two items. After this distribution of the undistributed amounts, the percentage of the fixed assets under each heading is figured, and the percentages are listed at the bottom of Table 4. The final percentage of the fixed assets which is allocable to fire protection is 34.39 per cent.

Fire Protection Service Charge

The amounts of revenue derived from the fixed assets of the water works, as determined above, is assigned to fire protection in the percentage of 34.39. To this figure must be added the amount of operation and maintenance expense which is assignable to fire protection; it consists of items such as maintenance of hydrants and the fire protection portion of the undistributed overhead expense. In this example, the operation and maintenance expense chargeable to fire protection was determined to be 7.70 per cent. The total revenue chargeable to fire protection was then determined to be 24.42 per cent of the total revenues of the water company. The revenue figure (24.42 per cent) was based upon the book cost or actual out-of-pocket original cost.

A similar computation was made on the basis of present-day reproduction cost. A figure of 17.70 per cent of the revenues based on reproduction-cost method was arrived at. The actual fire-protection charges made in these instances were $34,500 for the example based on book cost, and $35,800 for the example based on reproduction cost. We recommended, therefore, an amount of $35,000 as the fair charge for fire protection service. It will be noted that, for this example, the fire protection charge was practically the same with book value and reproduction value. In most instances a wide divergence may be expected.

Rates Computed by Other Formulas

Let us now consider fire protection charges determined by other methods of computation. If we use the Metcalf, Kuichling and Hawley equation for a population of 12,000, the percentage of the total cost of the water works involved in fire protection is 56 per cent. The 56 per cent ratio corresponds with 34.39 per cent derived by our method. After the fire protection portion of the operation and maintenance cost has been added, the total percentage of revenue

TABLE 4
Allocation of Fixed Assets on Basis of Initial Costs

	Total Account	Sub-Divisions	General Service %	General Service $	Fire %	Fire $	Undistributed %	Undistributed $
LAND	$ 6,983							
Power & Pumping		$3,025	100.00	$3,025				
Reservoir & Tank		3,958	79.38	3,142	20.62	$816		
STRUCTURES	114,643							
Source of Supply		2,112	100.00	2,112				
Pumping Station								
Pump Room		6,175	100.00	6,175				
Meter Room		5,575	100.00	5,575				
Heating System		1,499					100.00	$1,499
Reservoir		11,339	100.00	11,339				
Tank		65,891			100.00	65,891		
General & Miscellaneous Buildings		22,052					100.00	22,052
PRODUCTION EQUIPMENT	14,037							
Electric Pump		9,483	100.00	9,483				
Standby Pump		2,814			100.00	2,814		
Purification Equipment		1,740	100.00	1,740				
TRANSMISSION & DISTRIBUTION	799,675							
Transmission Mains		14,618	100.00	14,618				
Transmission to New Tank		3,846			100.00	3,846		
Distribution System		590,691	64.13	378,825	35.87	211,866		
Services		105,365	100.00	105,365				
Meters		54,575	100.00	54,575				
Hydrants		27,132			100.00	27,132		
Sprinkler Services (Private Fire Protection Only)		3,448						
GENERAL EQUIPMENT	21,633						100.00	21,633
MISCELLANEOUS PROPERTY	12,281						100.00	12,281
Total of Fixed Assets	$969,252							
Less Sprinkler Services	3,448							
Total Assets to be Distributed	$965,804			$595,974		$312,365		$57,465
Distribution of Undistributed				37,703		19,762		
				$633,677		$332,127		
Distribution of Costs			65.61%		34.39%			

chargeable to fire protection is 36.2 per cent. This is in contrast to the 24.4 per cent arrived at by our method.

The capacity-ratio method, recommended by the Joint Committee of the American Society of Civil Engineers and the Section of Municipal Law of the American Bar Association, involves two procedures for figuring the ratio; one procedure is based on the costs of the systems, and the other on the capacities of the systems.

In both procedures, two water works systems are considered, one to provide public fire protection only and one to provide general service only. In the first procedure, the jointly used facilities in the actual system are allocated between fire protection and other uses on the ratio of fire protection plant cost to the total cost of fire protection plant and general service plant. The other procedure is to make the allocation on the basis of the demand for water, the ratio in this case having as its numerator the maximum demand for fire protection, and as its denominator the demand for fire protection plus the maximum general service demand.

Using the costs of the distribution system developed for the incremental-cost method, it was possible to arrive at the cost of the distribution system for fire protection only, and the cost of a distribution system for fire protection only plus the cost of the distribution system for domestic service only. When this fraction was applied to the revenue to be derived from the fixed assets, and when the operation and maintenance expenses had been taken into account, it was determined that 35.9 per cent of the revenues for the water works should be derived from fire protection service. The same figure, using the demands of the fire protection system and the demands for the domestic system for determining the fraction, produced a percentage of the gross revenue of 35.5 per cent to be derived from fire protection. These figures are in contrast to the 24.4 per cent obtained by our method.

Actual Charges Reported

A study of the "Survey of Operating Data for Water Works in 1950," a staff report published in the Journal of the American Water Works Association, indicated that for forty-six private water companies only one company had a percentage of total revenue derived from fire protection greater than 20 per cent. Only seven had a percentage greater than 10 per cent, and five derived no revenue for fire protection service. A similar analysis of the revenue from municipally owned water works undoubtedly would indicate a much smaller percentage of revenue being derived from fire protection service than is indicated for private water companies.

Conclusions

It is erroneous to assume that the cost of the distribution system, which represents the greater part of the cost of most water systems, is proportional to the capacity of the system. This erroneous assumption was first made by Metcalf, Kuichling and Hawley in 1911 and is still used by current writers on the subject.

If this assumption is used in computing fire protection charges by all three of the general methods defined by the Joint Committee, and if the same flows are used in the computations, identical results will be obtained for that portion of the undivided fixed assets of the water works chargeable to fire protection.

The alternative approach suggested by the 1954 AWWA Committee is in error, because it assigns a storage charge in lieu of capacity and also a differential pipe charge to fire protection. If a storage charge is used in lieu of capacity, then we believe it is in error to also charge for the additional main capacity. Our studies show that the 4-inch pipe size differential used by the committee is too large.

We have developed and presented in this article a method of computing fire protection charges which we believe to be equitable and free from basic error. Our method is based on the philosophy that the cost of fire protection should be considered as an incremental cost, over and above the cost of general service. The cost of fire protection obtained by our method is substantially less than the cost computed by any other method commonly used.

The actual charge for fire protection services made both by private water companies and municipally owned water works is, in most instances, substantially below what the taxpayer should pay for the benefits he is receiving. The general rate payer is therefore paying more than his equitable share for the water he uses. We hope that our method will be utilized to fix charges for fire protection services which are commensurate with the service received, and that the general rate payer will thereby be relieved of the unjust burden he is now carrying.

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W&SW

Kennedy Elected President Of Portland Cement Assn.

G. Donald Kennedy, for the past year and a half Executive Vice-President of the Portland Cement Association, has been elected President of the Association. Mr. Kennedy, long prominent in the highway and automotive safety field, joined the Portland Cement Association in January of 1950 as consulting engineer and assistant to the president.

A graduate in civil engineering from the University of Michigan, Mr. Kennedy is a registered civil engineer in the states of Washington, Michigan and California. His memberships in technical organizations include the American Society of Civil Engineers, the Institute of Traffic Engineers, the American Public Works Association, and the American Society of Planning Officials.

As president of the Portland Cement Association, Mr. Kennedy will direct all activities of the organization, which include scientific research, the development of new or improved products and methods, technical service, and educational effort. The varied services of the Association to cement users are made possible by the financial support of more than 70 member companies engaged in the manufacture and sale of a large proportion of all portland cement used in the United States and Canada.

Industrial Water Manual Issued In Second Edition

The American Society for Testing Materials has published a second printing of its "Manual on Industrial Water". Fourteen new methods of testing, many revisions of existing methods, a complete table of contents, and a detailed index have been incorporated into the Manual.

This Manual is intended as a brief reference source of information for three types of users: executives and plant designers; individuals engaged in industrial operations involving the use of water; and analysts, operators of special instruments, engineers, and consultants.

The eight chapters included are: Uses of Industrial Water; Difficulties Caused by Water in Industry Composition of Industrial Water and Water-Formed Deposits; Treatment of Industrial Water; Sampling of Industrial Water; Analysis of Industrial Water; Sampling and Identification of Water-Formed Deposits; and Analysis of Water-Formed Deposits.

The price is $5.00 per copy. To ASTM members, $3.75 per copy. Address your order to The American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.

A. W. W. A. Board Actions

Frank Amsbary choice for president; Paul Weir for vice-president.
Black voted Diven Medal; Haney wins Goodell Prize.
Honorary Memberships bestowed on Ayers, Foote and Enslow.

THE Board of Directors of the Am. Water Works Association held its annual meeting in New York City, January 16th-18th, nominated for the three highest offices those named below; elevated three members to Honorary Membership; voted six awards, including for the first time three new awards, known as the Division Awards; established a basis for making the new Harry E. Jordan Scholarship Award; learned that the Pacific-Northwest Section showed the best record in membership increase during 1954; that the Alabama-Mississippi Section had the best meeting attendance record; learned that A.W.W.A. membership is pushing the 10,000 member mark strongly, with an all-time high of 9,940 and representing a net member gain of 480 in 1954.

Officers for 1955-56

A.W.W.A. officers are chosen by those members of the Board elected to represent the several sections in the Association. The following are the official choices and these nominees become automatically elected on March 1st unless there be other nominees named by the membership at large. In short, the nomination of the following as new officers is tantamount to election. They will be inducted into office at the close of the 1955 Convention, June 12-17, 1955, in Chicago.

FOR PRESIDENT:
Frank C. Amsbary, Jr.
Vice President and Manager
Northern Illinois Water Corp.,
Champaign, Illinois

FOR VICE-PRESIDENT:
Paul Weir
General Manager
Atlanta Water Works
Atlanta, Georgia

FOR TREASURER:
William W. Brush
Editor, *Water Works Engineering*
New York, New York

(Mr. Brush will be entering his 29th year as Treasurer of A.W.W.A.)

Three Made Honorary Members

Elected to Honorary Memberships were the following:

LINN HARRISON ENSLOW. Editor, *Water & Sewage Works*, New York, N. Y.

"Member of the Association since 1918. President of the Association 1948-49. Recipient of the Diven Medal in 1935. Served as a member of the Special Committee on AWWA Policy re Fluoridation of Public Water Supplies which received the Goodell Prize in 1949. Received the Fuller Award for the New York Section in 1951. Served as Chairman of the Association's Publication Committee from 1936 to 1947. Gifted with an inquiring mind and the will to search for truth. Responsible for many contributions to the advancement of chlorination, thus sharing the credit for the great gift to humanity derived from this forward step in sanitation."

LOUIS EVANS AYRES. Consulting Engineer, Ann Arbor, Michigan.

"A loyal and active member of the Association since 1916. A devoted worker within the Michigan Section. Director for the Michigan Section for the 1953-56 term. Received the Fuller Award in 1950. A consulting engineer of highest standing. The industrious leader of the Committee on Water Rates, stimulating his associates toward production of a valuable report which will serve as a guide to the water works industry for many years."

HERBERT BRANCH FOOTE. Retired Director, Div. of Environmental Sanitation, State Board of Health of Montana.

"Member of the Association since 1923. Director for the Montana Section 1931-33. Received the Fuller Award in 1942. While serving the people of Montana for many years as their State Sanitary Engineer, he was also responsible for the organization and growth of the Montana Section. Respected and beloved by all those who have worked with him."

Medals and Prizes

The DIVEN MEDAL, to that member who has rendered some outstanding service to the Association, was voted to ALVIN PERCY BLACK of the University of Florida.

"For constructive leadership in the establishment and maintenance of a sound policy for the water works industry concerning the fluoridation of public water supplies, together with his many important contributions to the Association and the advancement of water works practices."

The GOODELL PRIZE, to that member who has made a notable contribution to the science or practice of water works development, as recorded in the form of a paper published in the A.W.W.A. Journal, was voted to PAUL D. HANEY, Black & Veatch, Engrs., Kansas City, Mo.

F. C. Amsbary Jr.
Pres.-Elect

Paul Weir
Vice-Pres.-Elect

Harry E. Jordan
Secretary

Wm. W. Brush
Treasurer

"For his paper entitled "Theoretical Principles of Aeration," as published in the April issue of the AWWA Journal. This paper is a thorough and scholarly statement of the factors involved in the aeration of water and should prove to be a valuable reference source for many years to come."

Division Awards

New are the Division Awards. These awards may each year be made to one member from each of the four Divisions in the Association. The recipient is chosen by the Award Committee of each Division as the author of the best paper published in the

Journal in its field of interest during the year. The following have been voted the new Division Awards for the year 1954.

MANAGEMENT DIV. AWARD

To JOHN H. MURDOCH, JR. of the American Water Works Service Co., for the paper entitled "There Is Work to Be Done." This paper, published in the April 1954 issue of the Journal, points out the challenge that the water works field offers to young men choosing it as a career and offers inspiration toward progress for those already engaged in it.

DISTRIBUTION DIV. AWARD

To E. O. POTTHOFF of Genl. Electric Co. for his paper entitled "Motor Drives for Water Pumps." This paper with Mr. M. C. Boggis (nonmember) as coauthor, published in the October 1953 issue of the Journal, is particularly valuable as a practical guide to the selection of proper motors for water works pumping applications.

PURIFICATION DIV. AWARD

To PAUL D. HANEY of Black & Veatch, Engrs., for the report on "Characteristics and Effects of Synthetic Detergents."
This Task Group Report, published in the August 1954 issue of the Journal, most fully promotes the basic objectives of the Water Purification Division by stimulating research in the physical, chemical, bacteriological, and biological examination of water as related to the causes and effects of pollution and to methods of treatment. Its value to the technology and literature of the field and its quality of presentation are outstanding.
The members who served on the Task Group (Effects of Synthetic Detergents on Water Supplies) under the leadership of Mr. Haney are: R. L. Culp, J. D. Enright, W. D. Hatfield, H. E. Lordley, and J. C. Vaughn.

RESOURCES DIV. AWARD

To H. E. HUDSON, JR., of the Ill. State Water Survey for the report entitled "Water Conservation in Industry." This Task Group Report which was published in the December 1953 issue of the Journal not only outlines the various means by which industry is already cooperating in conserving the water resources of the nation, but calls attention to the need for the cooperative attitude of water works men in working with local industry on conservation problems.
The members who served on the Task Group (Industrial Water Use) under the leadership of Mr. Hudson are: Stephen Bergen, C. H. Capen, R. W. Davenport, L. L. Hedgepeth, H. R. Hooper, H. L. Mullin, W. J. O'Connell, S. T. Powell, M. J. Sassani, L. F. Warrick, and C. V. Youngquist.

Louis E. Ayers
Hon. Member

Linn H. Enslow
Hon. Member

Herbert B. Foote
Hon. Member

A. P. Black
Diven Medal

Paul D. Haney
Goodell Prize

John H. Murdoch
Division Award

E. O. Potthoff
Division Award

Herbert E. Hudson
Division Award

Section Awards

THE HILL CUP award to the Section showing the greatest membership gain during the year was won by the Pacific-Northwest Section. The giant California Section was the runner-up, and the Southeastern Section was third.

THE HENSHAW CUP award to the Section recording the greatest percent of its members in attendance at the annual meeting was won by the Alabama-Mississippi Section. The Ohio Section was second and the little Montana Section third.

THE OLD OAKEN BUCKET trophy which is held by the largest membership has never been won away from the California Section which boasts 1181 members. The Southwest Section (889 members) holds second place, with one hand on the relic, having eased the New York Section out of the No. 2 position.

The Harry E. Jordan Scholarship

The Water and Sewage Works Manufacturers Association has established a $1,500 annual grant to be named "The Harry E. Jordan Scholarship Award," to be conferred upon a student of high standing (male or female) selected by a special AWWA committee. In order to simplify the problem of selection, each year's grant will be made to a student in a school located in one of a limited group of states or provinces. Students to be considered must be enrolled in Engineering, Science or Business Administration courses in a College or University accredited by the Engineer's Council for Professional Development or by the American Association of Collegiate Schools of Business. In 1955, the schools from which the selection will be made are those located in Michigan, Wisconsin, Illinois, and Indiana. The committee to select the awardee will be F. A. Amsbary, Chairman; W. W. Aultman, M. B. Gamet, F. G. Gordon, and Thomas F. Wolfe. The first scholarship will be presented during the Awards Ceremonies at the Chicago Convention.

Engineers Joint Council To Hold Congress On Atomic Energy

Engineers Joint Council has announced organization of a Nuclear Congress and Atomic Exposition to be held December 12-17, 1955, in Cleveland.

The Nuclear Congress represents the biggest single project yet undertaken by the combined engineering and scientific societies of the nation. In addition to covering the interrelations of all branches of the nuclear sciences and engineering, both events have the active support of private enterprise and of government in the power and other atomic fields.

WATER WORKS PRACTICES

The Distribution System – Operation

The Twentieth of a Series

by GEORGE E. SYMONS, Ph.D.

Dr. Symons is Consultant and Technical Editor, Larchmont, N. Y. In this series he discusses *Water Works Practices* in the form of short course lectures. These are designed to assist plant operators, students, and all who wish to review fundamentals in this field.

OPERATION of a distribution system involves several problems and actions: Service line installations, flow and pressure studies, loss of carrying capacity, maintenance, meter reading and testing.

A . . . Service Installation

1. DEFINITIONS

a. The small line running from the distribution main to the point of entry into the customer's premises is termed the "service line."

b. The valve which is screwed into the main and to which the service line is connected is termed a "corporation cock."

c. Other valves in the service line are termed "shut-off valves."

2. MATERIALS

a. Most common materials used for service lines have been copper, red brass, wrought iron, steel, galvanized iron and lead. More recently plastic tubing is being used experimentally, with good results reported.

(1) Approximately 50% of all water utilities in the United States have used copper almost exclusively and another 40% have used copper with other materials.

(2) In times of national emergency, copper shortage has restricted its use and necessitated substitutes.

(3) Lead was popular at one time but is expensive and is subject to the dissolving power of soft waters with low pH.

(4) Cement-lined wrought iron has also been used, notably in the New England area.

b. New service line materials not in common use include: plastics, aluminum, terne-plated steel and steel-clad copper.

(1) Plastic pipe is generally known by its trademark name but is of a general class of organic, synthetic, or processed materials that are molded or cast.

(2) A study at the University of Michigan reported on 23 samples from four types of plastics (polyethylene, polyvinyl chloride, rubber-modified polysterene, and cellulose acetate butyrate).

(3) Indications are that certain types of non-toxic plastic pipe will be standardized for water service and will be acceptable and usable under varying conditions. Plastic materials have a temperature limit at which they begin to soften; this temperature limit is well above that of normal water supplies.

3. TAPPING

a. Drilling a hole in the main and inserting the corporation cock is termed "tapping."

b. Tapping of a main can be done under pressure with special equipment. In some cases tapping sleeves and pipe saddles are used.

c. The location of the tap on the periphery of the main varies in different localities.

(1) An AWWA survey of 210 communities in 1952 showed approximately

51% Tap at 45° with horizontal
26% Tap on side of main at center
18% Tap on top of main at center
5% Tap at other angles
5% Tap at more than one position

d. Approximately 90% of the taps are of the same size as that of the service line and 10% are smaller than the service.

4. SIZE OF SERVICE

a. In older communities, ½" or even ¾" service lines are now inadequate to supply the demands of a household. Lines of 1" and 1¼" or 1½" are more common today.

b. Modern practice in sizing of the service line takes into account the length of the line and the water demand as indicated by the fixtures.

c. Marsden C. Smith developed a standard design for water services at Richmond, Va. This method is detailed in *Wat. & Sew. Wks.* Vol. 95, No. 4, p. R-69 (1948).

(1) The method utilizes tables of fixture combinations, length of service, and size of service together with charts of flow in gpm versus length of service for different size meters.

(2) A load factor multiplier is used in the calculations to take into account the fact that not all outlets being served are used at the same time.

5. LOCATION AND OWNERSHIP

a. Where corporation cocks are installed on a main as it is being laid, the taps are made at distances equivalent to the lot width.

(1) Except in rapidly growing real estate developments, this practice is followed in only about half the communities in the United States.

(2) Reasons for not installing service lines to vacant lots are that many such lines will never be used; they may become a source of leakage; and when houses are built, the service line may be either the wrong size or poorly located.

b. Many localities prefer to install taps and services as needed, properly sized and located to serve the particular property.

c. On the matter of ownership:

The 1952 AWWA survey shows:
34% are installed by customer
66% are installed by utility, but 19% are charged to the customer

If services are replaced before

street resurfacing or installation of permanent pavement,

70% are paid for by the utility
30% are paid for by customer

d. In the matter of maintenance, the 1952 AWWA data indicate that out of every 100 communities

13 utilities maintain service from the main to the house
79 utilities maintain service from the main to the curb, or property line, while customer maintains service from curb or property line to house
8 customers maintain service from the main to the house

B . . . Field Studies

1. General

a. The subject of flow in a distribution system and the balancing of flows in a grid and the relation of these factors to sizing of mains has been discussed previously (see Distribution Systems, Part 2, Sect. A, 4 and 5).

b. The performance of an existing distribution system should be determined by tests. These tests should include: Measurements of flow in arterial mains and secondary mains; fire flow tests; loss of head tests; pressure tests; simultaneous flow and pressure tests; and leak or water waste surveys.

2. Flow Tests

a. Measurement of flow in arterial or secondary mains is done by the use of a pitometer.

b. The instrument, a reversible pitot tube, is inserted into a main through a 1-in. corporation cock. It will measure flow in either direction and the measurement can be recorded over a period of hours or days.

c. Flow measurements show which mains are carrying their share of the load, which are overloaded and which are not carrying the expected load.

d. These tests may indicate closed or partly closed valves, obstructions, air pockets or other conditions that may be remedied easily.

3. Fire Flow Tests

a. Commonly termed hydrant-flow tests, the test for fire-flows requires observations of residual pressure at one hydrant while the flows from a group of neighboring hydrants are measured.

b. Tests should be made of *groups* of hydrants that might be utilized for fighting a serious fire; water should be withdrawn at a rate to create a pressure drop unaffected by normal water demand; and the tests should be made at times when consumption is normal in all parts of the system.

c. The technique of the fire flow test is as follows:

(1) At the particular point where information is desired, place a gage on a fire hydrant (hydrant A) and read the gage.

(2) Place a hydrant pitot gage in the nozzle of another hydrant, (hydrant B).

(3) Open the nozzle on the second (B) hydrant and read the pressure on the pitot gage and the residual pressure on hydrant A.

(4) In order to obtain sufficient pressure drop, it may be necessary to open more than one hydrant and make pitot gage readings on each.

(5) Calculation of flow in the open hydrant is

$$Q = 27\,D^2\sqrt{P}$$

where Q = gpm
D = diameter of nozzle in inches
P = pitot-gage pressure in psi

(6) The approximate amount of water available at 20 psi residual pressure (the minimum desirable) is determined by

$$Q_r = Q_t\left(\frac{P_r - 20}{P_r - P_o}\right)^{0.5}$$

where Q_r = gpm at residual pressure of 20 psi
Q_t = total discharge of the open hydrants (B, C, D, E)
P_r = pressure in psi at hydrant (A) with all hydrants closed
P_o = residual pressure in psi at hydrant A with hydrants B, C, D, E open

4. Pressure Tests

a. Pressure at any point in a distributing system is depended on the input pressure, elevation, and loss of head in the system.

(1) Pressures for domestic service should be between 40 and 100 psi; 40 to 50 psi in the minor distributors.

(2) Fire pressure should be sufficient to produce 75 psi nozzle pressure if buildings exceed three stories; less than that is satisfactory in smaller communities.

(3) Fire pressure may be obtained by increasing the pumping pressure or by mobile fire pumper drawing water from a hydrant.

b. Pressure tests made at hydrants throughout the system produce information of less value than fire-flow tests. They should be made at times of minimum flow (nighttime) and during normal daytime flow.

c. Recording of pressure at critical points is desirable. Sudden changes in pressure may indicate the development of a large leak; slow decreases in pressure may indicate that the system is becoming overloaded or that the mains are losing carrying capacity.

5. Loss of Head Tests

a. Loss of head tests are made to determine the internal condition of mains.

b. Two pitometers, with attached manometer and accurate recording gage, are used; one at each end of the section of main under test.

(1) During the test, all branch lines are shut off so no water can be withdrawn from the test section by consumers.

(2) Observations are made for a period of time on both manometers and gages; at the completion of the test, the gages are compared then switched and another test made.

(3) The pressure readings at each point are converted to feet and the elevation of the pipe, at each point, is added; the difference between the total head at the two points is the loss of head.

(4) The flow velocity is determined from the pitometer reading.

c. The loss of head divided by the length of test section is the hydraulic slope which is reported in feet per 1000 ft of pipe.

d. From the slope, velocity and pipe diameter, the roughness coefficient of the pipe (C) can be determined.

6. Hydraulic Grade Study

a. Simultaneous observations on flow and pressure may be made to determine the hydraulic grade in various sections of the system, particularly in critical areas.

b. This is done similarly to loss of head tests, except that no valves are closed. Pitometer and gage readings are taken at the points desired.

(1) To the gage reading (in feet) is added the elevation.

(2) These data when plotted as total head against distance from source or pump station give the hydraulic grade at the observed flows.

(3) Hydraulic grades should be determined from different flow conditions (maximum, minimum and normal).

c. If the hydraulic grade data are plotted on a map of the distribution system, contour lines connecting points of equal total head can be drawn. If the contour lines are uniformly spaced the system is well balanced and vice versa.

7. Waste Water Surveys

a. The amount of water pumped is greater than the amount of water

sold, as indicated by totallizing meter readings. This difference is termed *non-revenue water*. It has also been termed "unaccounted-for water," but since it is a calculated volume based on estimates of free use, leaks, etc., some persons prefer the term non-revenue water as indicating that which enters the system but produces no income. Non-revenue water should not exceed 10 per cent unless some special condition affects the situation.

b. Non-revenue water may include leakage, non-registered flows through defective meters, low flows passing meters too large to register the small flow, or even stolen water.

c. Waste water surveys of a distribution system will usually locate large leaks and make it possible to materially reduce waste in the form of non-revenue water.

(1) These surveys are usually made at times of minimum water use.

(2) Valves are shut off to make all water to a single district pass through a single pipe.

(3) A pitometer is inserted into the pipe and the flow determined; if greater than normal for the time of day, the district is divided into smaller sections and each is studied to locate the point of abnormal flow.

d. Finding leaks, once the area is located, may be done in several ways; each has its advantages; none is universal.

House to house inspection
Direct observation of ground surface
Observation of sewer flows
Sounding rods
Study of hydraulic grade line
Listening for sound of leak with sonoscope (aquaphone, detectaphone) or electronic sound amplification
Blowing air in pipe (for submerged pipe)
Water hammer

e. Leaks should be held to below 250 gal per 24 hr per inch of pipe diameter, per mile of pipe (e.g., 7500 gal per day per mile of 30 in. pipe).

8. Main Line Meter Tests

a. Most main line meters have high accuracy and will maintain such accuracy for years, but periodic checks are advisable.

b. Errors in reading can occur due to foreign bodies in the primary measuring device, or to faulty transmission, improper placement of transmitters and secondary instrument, or to wear in the parts of a secondary instrument, etc.

c. There are several ways of checking the accuracy of major measuring devices, including comparisons with pitot tube measurements.

C . . . Loss of Carrying Capacity

1. Causes of Loss

a. Decreases in the carrying capacity of a pipe line result from increased friction in the system, due to interior roughness of pipe, or decrease in the internal diameter of the pipe.

b. Friction is increased when the interior surface of the pipe becomes rough.

(1) Corrosion and pitting of pipe causes a rough surface.

(2) Tuberculation, a form of corrosion which results in rough and irregular projections, or tubercles, forming on the inside of the pipe.

. . . Tubercles are conelike barnacles, usually the result of chemical and bacterial action growing in concentric layers with a central portion usually black and soft, containing iron sulfide. They consist mostly of ferric hydroxide but may also contain some lime, silica, and organic matter.

(3) Deposits of sediment or organic matter precipitated from after growth of biological organisms.

(4) Slime growths, particularly in transmission mains.

(5) Accumulation of air in a long pipe or network at a high point also causes loss of carrying capacity.

2. Remedies

a. Cleaning pipe lines by scraper.

(1) Water pressure behind a turbine scraping device pushes it along removing tubercles and deposits. Often a cable is attached to permit its recovery or locates it if it sticks.

(2) The scraper moves at about 4 mph, requires about 65 psi pressure in a 12-in. line.

(3) Deposits are washed ahead of the scraper and discharged above ground from a discharge section, inserted by making a cut in the main.

(4) Cleaning by this method may leave the surface unprotected by removal of coating, and subject to further corrosion and tuberculation; thus once scraping has been introduced, it must be repeated at more frequent intervals.

(5) Pipe cleaning is done on contract by several established firms or can be done by the water utility itself.

b. Cleaning and lining.

(1) To avoid the necessity for repeated cleaning by scrapers, pipe may be given a thorough cleaning and thereafter cement lined in place.

(2) A 1:2 Portland cement mortar is used and the lining is applied to a thickness of 3/16 to ¼-in.

(3) For pipes 4 to 15-in. in diameter, the Tate process is used.

. . . Branches and service connections are disconnected in a section 300-500 ft. long, corporation cocks are removed and the holes plugged.

. . . The main is scraped, wire brushed and a rubber squeegee drawn through several times to leave the pipe walls clean.

. . . Sufficient cement mortar is then added to one end of the section of main to line it completely with some surplus. A bullet nosed lining tool, ½-in. less in diameter than the pipe, is drawn through the section of main.

. . . The lining machine compresses the mortar against the pipe and leaves the surface smooth. Plugs are removed and moist warm air is blown through for 15 to 20 hr. The pipe is filled with water and cured for 10 to 12 hr.

. . . Cost of lining is about one-third the cost of replacing with new mains.

(4) Pipes 16 to 144-in. in diameter are lined by a special centrifugal lining machine, after cleaning.

. . . There are two types of machines; one applies the dense cement-mortar, previously mixed, and then trowels the surface; the other applies a mixture of sand and cement from a rotating nozzle under air pressure, like the gunite process, a four bladed trowel follows the application and smooths the surface.

(5) Pipe lining in place is performed on contract by at least three reliable and competent firms.

c. Cleaning with Acid

(1) In small pipes, calcium carbonate deposits, rust and most tubercles can be removed by treatment with muriatic acid (commercial HCl) providing an inhibitor is used in the acid.

(2) Inhibitors have no effect on the reaction between the acid and calcium carbonate or rust but do prevent action of the acid on metals.

(3) Inhibitors used include aniline, pyridine and quinoline. Two per cent of aniline oil in a 5 per cent muriatic acid solution will reduce its corrosive activity on metals by 97 per cent.

d. Corrosion Prevention

(1) Protective coatings are applied to all new metal pipe. Pipe already in place can be lined with cement (see above) and some efforts have been made to apply a bitumastic lining in place under the influence of an electrical potential, but other protective coatings (rubber base paints, plastic) cannot as yet be applied to lines in place.

(2) Treatment of water to reduce aggressiveness

. . . Deaeration in industrial supplies (not practical for municipal supplies).

. . . pH adjustment in acid waters
. . . adjustment of the carbon dioxide-calcium carbonate equilibrium to cause a deposition of a thin layer of protective calcium carbonate on the pipe.

. . . Threshold treatment with 1 to 2.0 ppm of glassy phosphate, e.g., sodium hexametaphosphate ("Calgon", etc.), reduces corrosion and its manifestations — notably red-water, laundry discoloration and fixture staining.

(3) Cathodic protection or the impressment of a small electric potential on a pipe line or elevated tank will reverse the electro-chemical action of corrosion and prevent the iron or steel from going into solution.

. . . In this case the current passes from a sacrificial electrode of magnesium, carbon, etc., to the metal to be protected. The electrode wastes away and has to be replaced.

e. Slime Control

(1) Biological growths in aqueducts and transmission mains often cause serious reduction in carrying capacity.

(2) Continuous or intermittent chlorination, and chlorine-ammonia treatment, have been used effectively to reduce and control slime growths and restore pipe line capacity.

f. Air Relief

(1) Installation of air relief valves at high points eliminates air locking.

(2) Lowering the pipe line at the high point, to hold it below the hydraulic grade, may also eliminate the trouble.

D . . . Maintenance

1. Repairing Leaks

a. Joint leaks are repaired by recalking.

b. Cracks are repaired by using split sleeves, by cutting out a section and replacing by mechanical joint, or by replacing the whole length of pipe if necessary.

c. Valve shut-off in the area affected is usually essential, especially in severe main breaks. Mechanical or motorized valve closers and openers aid materially in rapid shut-off of valves.

d. Freezing of mains by applying a mixture of dry ice and melting liquid (gasoline) has been used successfully for shutting off mains for repairs. The larger the pipe the longer time it requires for freezing a six inch main having been frozen in two hours with 150 lbs of dry ice and 7 qts of gasoline.

2. Flushing Dead Ends

a. Accumulations of rust, organic material, etc., in quiet waters of dead ends causes tastes, odors, color.

b. A regular flushing schedule helps to maintain the quality of water in dead end systems.

(1) Flushing is done by opening fire hydrants for full discharge and allowing water to flow until reasonably clear.

(2) Inadequate or improper flushing may stir up sediment without removing it.

3. Emptying Mains

a. Mains may need to be emptied before cleaning or repair.

b. Methods used include (1) opening hydrants at high point and low points and allowing water to flow out by gravity or (2) by introducing compressed air at a high point and forcing water out at lower point.

4. Water Hammer

a. Pounding in distribution systems (water hammer) is caused by the sudden stoppage of flow of the water column and resultant development of extremely high pressures which rebound and recur at periodic intervals until the energy is dissipated.

b. Original causes of water hammer include sudden closing of valves; sudden starting, stopping, or variation in pump speed; and breakage in pipe lines.

c. Methods for control of water hammer include relief valves, air relief, surge towers, surge suppressors, aid chambers and installation of slow closing valves—especially the needle and cone types of valves.

5. Finding Pipes

a. In case records are incomplete or inaccurate, pipe lines must be located if repairs are necessary or for other reasons.

b. Pipe locators are used for pipe line finding. One type works with the pipe as a part of a closed electrical circuit; another type utilizes an aerial which picks up the magnetic field induced in the pipe by radio transmitter. In some cases a magnetic needle will serve.

6. Valves and Hydrants

a. If valves and hydrants are not opened and closed at regular intervals, they may become inoperative, due to rust, corrosion or dirt.

b. Valves should be operated at least twice each year. Mechanical or electrical valve operating units reduce the work involved in this maintenance operation. Records should be kept of the number of turns required to open or close each valve and of the position (open or closed) in which the valve was left.

c. Kerosene or diluted lubricating oil poured down the valve key may aid in loosening a valve stem which binds due to dry packing.

d. Hydrants should be inspected every three months. In areas which have severe winters, hydrants should be inspected three or four times a month and water in the barrel removed after each use or if it accumulates due to leakage.

7. Elevated Storage

a. Cleaning and painting of elevated tanks, both inside and out, is the most common and best protection against storage facility deterioration.

b. Replacing rivets, patching leaking steel tanks, cleaning and painting should be done under careful supervision by experts of which there are several companies. Great care should be exercised not to employ inexperienced or unscrupulous contractors for this type of work.

c. AWWA specifications should be followed for repairing elevated storage tanks.

d. Installation of cathodic protection will prevent corrosion of steel water tanks. However, before installing cathodic protection the tank should be first cleaned and given a good protective coating.

e. Prestressed concrete tanks may need surface repairs.

8. Thawing Pipes and Services

a. Electrical thawing is the most common method; gasoline engine-generator sets are used. Maximum power required is 89 bhp giving 500 amp at 100 volts. Current is controlled by rheostat in accord with size of pipe.

b. Alternating current from municipal power lines may be used but it is necessary to step the current down to 110 or 55 volts.

c. Mains may be thawed in 600-ft lengths if 100 volts are used or 300-ft lengths at 55 volts. Services may be thawed with 50 volts or less.

9. Cleaning Service Lines

a. Service lines become clogged from sediment from mains. They may be cleaned by dragging or pushing a scraper through them or by blowing with compressed air.

b. Scrapers consist of cutting knives, brushes, etc., on flexible rods twisted by power.

c. Service line "shooting" is done by releasing a mixture of compressed air and water at pressures up to 1400 psi. A loss by bursting of only 10

per cent of the pipes and 70 per cent success has been reported.

E . . . Meter Testing

1. Sizing and Installation

a. Choice of the size of meter should be done according to the size of the service line and the probable customers demand.

b. Installation of new meters is not maintenance in the usual sense but is usually done by the same staff that removes, tests and repairs old meters.

2. Removal and Replacement

a. Causes for removal of meters include freezing, stoppage, under-registration and over-registration (either actual or claimed).

b. AWWA specifications recommend that ⅝-in. meters be removed and replaced every ten years; larger meters should be changed more often. Some utilities remove and check every seven years. In reality, there can be no fixed rule as to justifiable frequency of removal and testing of household meters. The quality of water will determine how long a meter will remain accurate in service, also how much water has passed through the meter.

c. Meter maintenance shops should have a regular program for handling removed meters. This program should include testing, dismantling, cleaning each part, replacing worn parts, reassembly, painting, and testing at ¼; 1, 4, and 14 gpm for a ⅝-in. meter.

(1) No house meter should be put in service unless it is 95 per cent or more accurate at ¼ gpm. At higher rates accuracy should be within 1 per cent high or low.

(2) Regular testing and replacement of meters should reduce non-revenue water by as much as 10 per cent.

F . . . Other Operation Problems

1. Safety

a. Establishment and continuation of sound safety practices are particularly important in all maintenance programs.

b. Outdoor operations require one type special safety precautions and shop operations another; both are based on common sense.

2. Communications

a. In maintenance operations it is necessary to maintain close contact between maintenance crew and the dispatchers office.

b. Mobile radio telephone is considered the most desirable. It may be part of the police or fire department or a separate water works system. Experience indicates the latter is preferable by far.

3. Illegal Use of Water

a. Stolen water is not generally a large percentage of non-revenue water, but it should be guarded against.

b. Illegal consumption may be obtained by bypassing the meter (a jumper); inducing low unrecorded flows by "dripping." This practice can be done by causing toilet storage tanks to fill at rates less than ¼ gpm.

c. Builders and other unauthorized personnel often connect to a fire hydrant to obtain water without paying for it.

d. Meter readers and maintenance crews alert to these practices, can keep them to a minimum.

G . . . References

Material for this lecture was based on current technical literature and several reference texts which included:

Babbitt and Doland, "Water Supply Engineering" (McGraw-Hill)
Fair & Geyer, "Water Supply and Waste-Water Disposal" (John Wiley & Sons)
Hardenbergh, "Water Supply and Purification" (Int. Textbook Co.)
Steel, "Water Supply and Sewerage" (McGraw & Hill)

Next Lecture

"Instrumentation and Control."

Cross Reference Index to Distribution System Topics

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Sanitary Engineer Reserves Neeeded In Disaster Relief

by HARVEY F. LUDWIG

Mr. Ludwig is Chief, Engineering Resources Prog., U.S.P.H.S., Wash., D. C. He describes the responsibilities of our Public Health Service for developing a national civil defense program in public health. A professional engineer reserve corps is essential and must be trained to meet new problems.

FOR MORE than 40 years, the commissioned reserve corps of the Public Health Service has been an essential element in Public Health Service operations. During World War II, for example, the expanded responsibilities of the Service, both at home and abroad, were largely carried out by reserve officers on active duty. Most of these were recruited following the onset of the war emergency. The situation in those years allowed time to make arrangements to cope with the new problems after their emergence.

Now the picture is drastically changed. A new look is required. The advent of nuclear weapons, especially the hydrogen bomb, and of other special weapons, such as biological warfare agents, has created the very real possibility of a national health emergency of tremendous proportions. In recognition of this situation, the Federal Civil Defense Administration has delegated to the Public Health Service, Department of Health, Education, and Welfare, responsibility for developing a national civil defense program in public health. The delegation, made in July 1954, and approved by the President, includes the specific instruction that the Department is to "plan, develop, and direct Federal activities concerned with a national program designed to provide Public Health Service reserve professional personnel from support areas to those damaged by enemy attack." The engineer component of this reserve is of immediate interest.

Sanitary Engineering Emergencies

Studies of the anticipated situation resulting from simultaneous atomic attack on many cities show that the work of the sanitary engineer will be of paramount importance. Next to emergency casualty care, emergency sanitary engineering operations may be most significant in making it possible for the surviving population to continue to survive. It must be anticipated that much or most of certain essential facilities — the community water supply; facilities guarding the storage, handling, and consumption of food; housing and shelter; waste disposal works, etc.—will have been destroyed. The problem will be to restore as much of these facilities as possible to some level of operation as promptly as possible, and to make minimum substitutes available to hundreds of thousands of people.

The numbers of trained sanitary engineers competent to manage such problems are few, compared with the magnitude of the expected needs. The prompt mobilization and deployment of engineers to attacked areas, and continuing redeployment to meet the changing situation, will be necessary. The reserve corps of the Public Health Service furnishes the mechanics for accomplishing such rapid mobilization and deployment, but it is obvious that these personnel must be recruited prior to the emergency.

Moreover, it is quite apparent that the types of engineering skills needed for emergency health operations will differ in many instances from those required for normal health department activities. Such operations as radiological monitoring, temporary construction, and repair of public works will require the contributions of many sanitary engineers not normally working under health agency jurisdictions. The target for the total strength of the engineer component of the Public Health Service reserve has been tentatively established at 1,000.

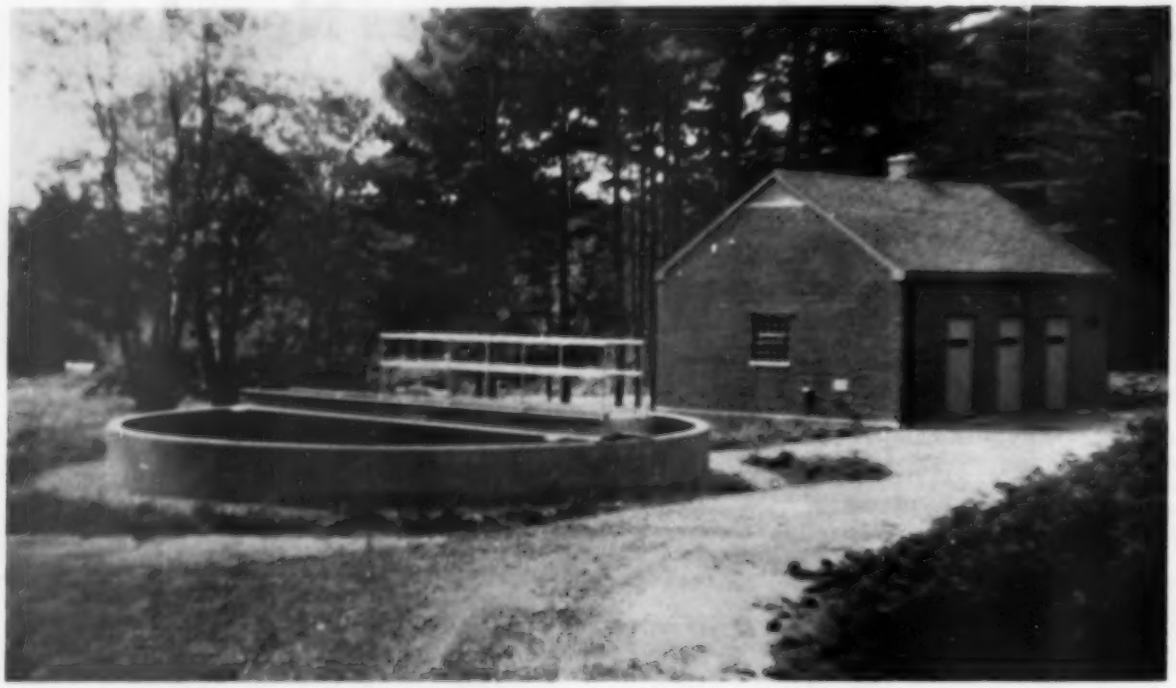
Information Program in Operation

It is recognized that the minimum step in preparing the engineer reservist for possible active duty is an up-to-date information program which keeps him advised of the immediate aspects of the changing civil defense problem and of the status of the regular sanitary engineering programs of the Public Health Service. To meet this need, all engineer reservists are now regularly furnished with copies of the Sanitary Engineering News Letter, a quarterly issue of the Sanitary Engineering Services Division of the Public Health Service, and periodic news bulletins issued by other Public Health Service components engaged in sanitary engineering operations. They are also sent copies of many other technical publications and releases.

These publications will keep the reservist advised of opportunities to participate in short-period, active-duty assignments. Short-period assignments underway this fiscal year include training courses specifically in civil defense, the atomic test fallout monitoring program, natural disaster relief operations, and various special assignments. Inactive reservists are being polled regularly to determine their current interests in such assignments, which range in duration from a week or two up to two years.

It can scarcely be over-emphasized that civil defense presents ever-changing problems. Each such change increases the difficulty of the problems facing the sanitary engineer, as the solutions to these problems become increasingly unorthodox compared with his regular approaches. Practical techniques need to be continually adapted to the changing conditions. Several of the current research programs of the Public Health Service are focused on this objective. Through the inactive reserve corps it is hoped to inform a considerable segment of the practicing sanitary engineers.

Further information on the engineer component of the inactive reserve may be obtained from M. D. Hollis, Chief Engineer, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C., or from the Public Health Service regional engineer offices.



FINAL settling tank and recirculating pumping station

Modern Sewage Works for Meredith, N. H.

by **EDWIN B. COBB**, *Partner, Metcalf & Eddy, Engrs.*
Boston, Mass.

THE town of Meredith is located in the central portion of New Hampshire at the northerly end of Lake Winnepesaukee. The business center, known as the village, is located at the head of Meredith Bay between the bay and Lake Waukewan. The village has a year-round population of 1,400 to 1,500 persons. Its principal business activity is serving the summer residents and visitors who come to enjoy the beauties of the lake region. However, there is one important industry, an asbestos textile mill.

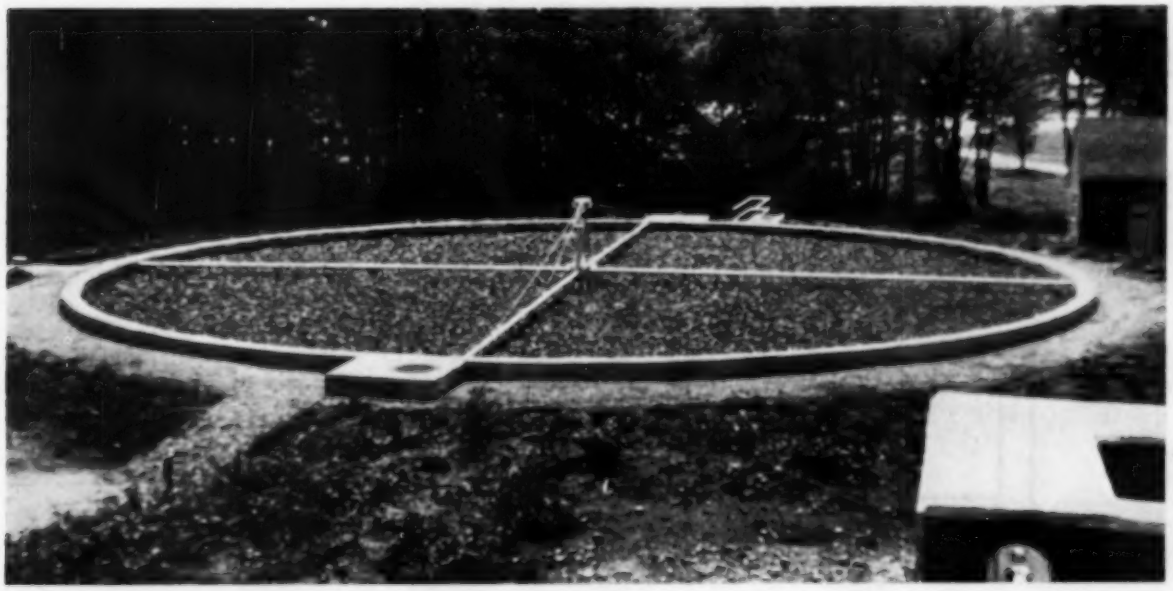
In much of the area of the village, the ledge rock is exposed or is close to the surface, and the overlying soil is largely impervious. Other areas along the lake are low-lying and swampy. Such conditions make the private disposal of sewage difficult. Numerous overflowing cesspools have been noted. Along Main Street, sewage is discharged to stormwater drains and elsewhere sewage has been directly discharged or allowed to seep into water courses or the lakes. In warm weather the catchbasins along Main Street emit very foul odors.

Sewerage and Treatment Become Necessary

Urged by the State Health Department, the Town in 1938 engaged Metcalf & Eddy, Engineers of Boston, to report on remedial measures for the problem of sewage disposal in the village. A report was submitted in February 1939, recommending a system of sewers, a sewage pumping station, and a sewage treatment plant estimated to cost about $312,000. The 1939 Town Meeting first voted to proceed with the recommended works, but the opposition, biding its time until most of the supporters of the measure had gone home, moved reconsideration, and subsequently defeated the measure.

Various forms of opposition, wartime restrictions, and other difficulties, stalled further progress in solving the sewage problem until the enactment of the New Hampshire Water Pollution Act on July 1, 1947, brought the threat of legal action by the State because of the pollution of the lakes. In November, 1947, Metcalf & Eddy were engaged to review their 1939 report, to present revised estimates of cost and to recommend a method of financing the works.

The review brought some minor revisions in the recommended works and the estimated cost was revised upwards to $646,000 for the complete works. A method of financing divided between taxation, betterment assessment, and sewer



STANDARD *rate trickling filter is a circular unit*

rentals was recommended. The 1948 Town Meeting voted authority to raise a $350,000 bond issue to finance the work. Metcalf & Eddy were engaged to prepare plans and specifications for the proposed construction.

Sewage Collection System

The sewerage system is designed to serve only the village. In its foreseeable development, it will contain about 630 ft. of 12-in., 1,260 ft. of 10-in., and 33,000 ft. of 8-in. sewers. In an effort to keep groundwater infiltration to a minimum, all sewers lying below the level of Lake Winnepesaukee are of Class 100, cement-asbestos, pressure pipe with simplex-type joints. Sewers above the lake level were specified to be of vitrified clay with poured bituminous-type joints. However, at the request of the contractor who laid most of the cement-asbestos sewers, certain additional sewers were also constructed of cement-asbestos pipe because of observed economies in construction.

Portions of manholes below lake level were specified to be of concrete with brick construction permitted above. The contractors have elected to use precast concrete manhole barrels on all manholes, thus far, with very satisfactory results.

Foundation conditions for sewers near the lake front were unfavorable, but the liberal use of screened stone cradle for the pipe and for refill below grade overcame this condition. The flexibility of the simplex joints, without loss of watertightness, permitted the construction of satisfactory sewers on the yielding subgrade.

The sewerage system drains to a sewage pumping station located on U. S. Route 3 about 700 ft. northerly from the end of Meredith Bay. An emergency overflow has been provided discharging to Lake Winnepesaukee in case the pumping station must be bypassed.

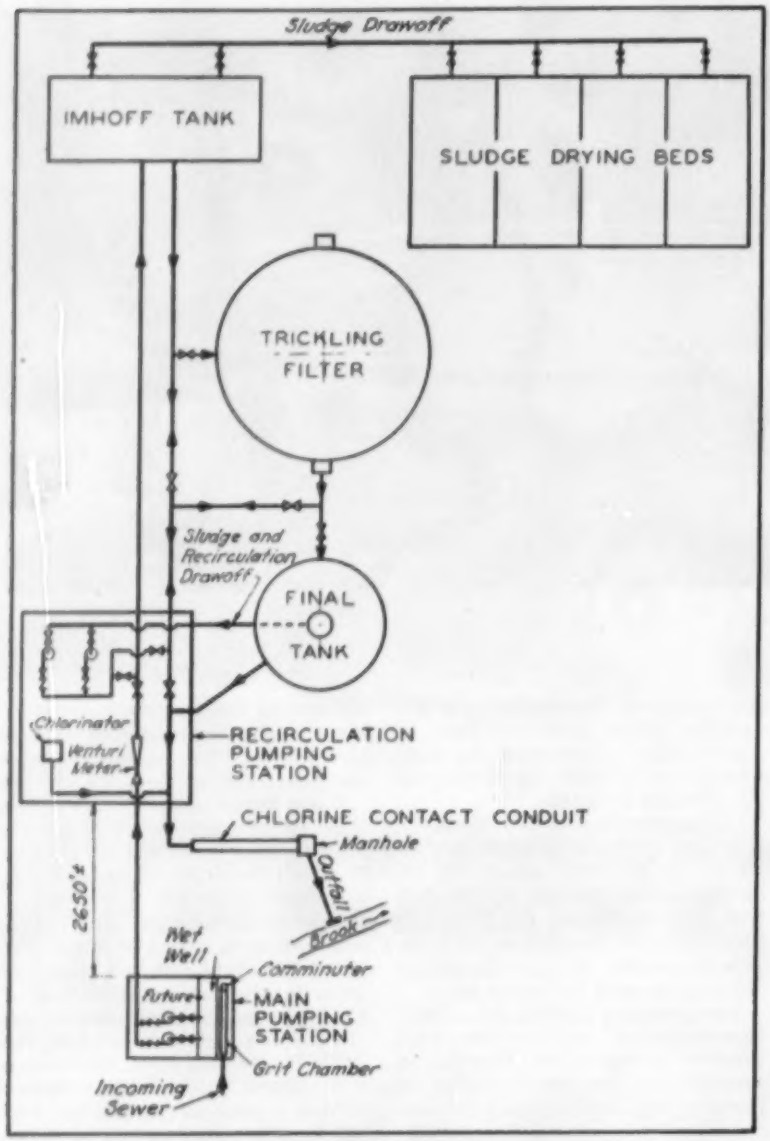
The pumping station has a brick superstructure and a reinforced concrete substructure. Foundation conditions in the area available for pumping station location were generally very poor, and normally would require a pile foundation. However, by chance, an outcrop of ledge was discovered about 10 ft. below the surface at a suitable location for the station and the station was founded on the ledge thus avoiding the use of piles. Thanks to an overburden of fine material, the ledge was excavated well below lake level with only a small amount of groundwater infiltration being experienced.

Pumping Station Design

The station is divided into two separate parts; the wet-well portion, and the pump room and motor room portion. Passage between the two portions may be made only by going out-of-doors. This physical separation prevents the possibility of explosive gases emanating from the sewage entering the room housing the electrical equipment, and also protects the equipment from dampness arising from the sewage.

Upon entering the pumping station, the sewage flows along the narrow channel about 1 ft. in width, in which the depth is controlled by a weir to maintain a velocity of flow of about 1 fps and thus permit the separation of grit from the sewage. Grit will be removed manually from the channel from time to time. From the grit channel, the sewage flows through a Worthington 15VV4 comminutor, and thence into the wet well. A bypass channel with a manually cleaned bar rack has been provided in case of failure of the comminutor, or when the grit channel requires cleaning.

The pump room was designed for three vertical, nonclog, sewage pumps. Initially, two Fairbanks-Morse 280 gpm bladeless pumping units have been installed. One unit has a dual gasoline engine, electric motor drive and the other an electric motor drive only. The future third unit will be of the same size and will have an electric motor drive only. With the third pump installed, the station will be able to handle the design maximum sewage flow of 400 gpm, while holding the third pump as a standby. Operation of the gasoline engine at high speed will permit one pump to handle the maximum design flow during times of power failure. The pump motors are in the motor



FLOW DIAGRAM of the new Meredith, N. H., sewage plant

room at ground level as is the motor for the comminutor.

The pumping station discharges the sewage through an 8-in. cement-asbestos force main about 2,650 ft. in length leading to the sewage treatment plant. The plant is located northerly of the village in a pine grove where it is well screened and isolated from all residences.

Treatment Plant Features

The sewage treatment plant consists of a rectangular Imhoff tank, a circular standard rate trickling filter, a circular final settling tank, a chlorine contact conduit, a recirculation pumping station, and open sludge drying beds. The principal features of the plant are illustrated in the flow diagram.

The recirculation pumps consist of two units of 180 gpm capacity each. These pumps draw humus sludge and treated sewage from the bottom of the final settling tank and discharge it to the Imhoff tank. A Venturi meter in the basement of the recirculation pumping station records the flow of sewage from the main pumping station. When the flow at the Venturi meter is zero a recirculation pump is automatically started by contacts in the meter instrument. Later, when the flow is resumed from the main pumping station, the contacts in the meter instrument open and the pump stops. This arrangement assures continuous operation of the trickling filter distributor to prevent freezing in winter and fly breeding in summer. Also, the humus sludge is automatically removed from the final settling tank and discharged to the Imhoff tank.

Effluent from the final settling tank is chlorinated, using a Wallace & Tiernan type MSVD chlorinator. The chlorinated effluent is discharged to a 24-in. vitrified-tile pipe 250 ft. in length having a dam at the outlet which causes the pipe to flow full. The time of passage through the conduit assures adequate contact of the chlorine before discharge.

Final settling tank effluent is used in the chlorinator injector for solution water and to produce a vacuum. A small pump supplies the necessary water and the operation of the pump is controlled by contacts on the Venturi meter instrument. When the instrument indicates a flow the contacts close and the pump starts. When the flow ceases and the indicator returns to zero the contacts open, but a delay-type relay of adjustable range keeps the pump in operation up to 15 min., as selected, after the contacts are opened. The arrangement ensures that chlorination will continue until the discharge of effluent from the final settling tank has substantially stopped.

Recirculation Pumping

The architectural style of the recirculation pumping station is similar to that of the main pumping station. The superstructure is divided into a chlorinator room, a storage room, and an office. The office contains the Venturi meter register and the electric control center. A toilet and lavatory room is connected to the office.

In the basement are the recirculation pumps, flushing water pump, chlorine injector water pumps, Venturi meter, oil heater, and jet-type well pump and hydropneumatic tank. The flushing water pump draws its supply from mid-depth in the final settling tank and the chlorine injector water pumps from the tank effluent. The jet pump draws fresh water from a wellpoint located just outside the station. The fresh water is used for makeup water in the chlorinator tray, and for toilet flushing, and in the lavatory. Toilet and lavatory wastes are disposed of in a small steel septic tank with tile leaching field located behind the station.

The sludge drying beds are four open sand beds each 40 by 20 ft. plan and divided by wooden partitions. There are no underdrains under the filter sand inasmuch as the beds are located over a deep layer of sand which although fine appears to have adequate porosity. The beds were surfaced with 12 in. of coarse sand.

The plant effluent is discharged into a small brook running past the plant. This brook flows into a swamp and thence finds its way into Meredith Bay.

Construction Contracts

The work has been divided into a number of construction contracts. Contract 1 included the main pumping station and the sewage treatment plant. Contract 2 included most of the sewers below lake level and those discharging directly to the pumping station. Contract 3 included sewers in Main Street and through certain parts of the business district. Contracts 4 and 5 will extend the sewers into the side streets.

The work was started during the Korean emergency when because of governmental regulation, deliveries of equipment were most uncertain. To facilitate the placing of orders and to relieve uncertainty in bidding construction contracts the Town purchased the cement-asbestos pipe and the major items of equipment. The procedure reduced the delays but the divided responsibility has made the supervision of the work more difficult.

Contracts 1 and 2 were completed during the summer of 1953 and Contract 3 during December, 1953. Contracts 4 and 5 are to be delayed for a period until levies for sewer assessments begin to accumulate.

Financing Methods

The works are to be financed in the following manner:

1. *General Taxes*
   Construction cost of main pumping station, force main, sewage treatment plant, and portions of sewers along U. S. Route 3 where only limited assessments can be levied.
   One-third the construction cost of all other sewers.
   One-third the cost of operating the works.
2. *Betterment Assessment*
   Two-thirds the construction cost of sewers except as noted above.
3. *Billed to Owner of Property*
   Construction cost of "building sewers."
4. *Sewer Rental Based on Use of Water*
   Two-thirds the cost of operating the works.

The purpose of financing a portion of the cost of construction and operation of the works from taxes is to distribute some of the cost throughout the whole Town since everyone will receive some benefit from more sanitary conditions in the business center and in the lakes.

The Engineers also have assisted the Town in drawing up a sewer ordinance. This ordinance was based upon the "model ordinance" contained in the Federation of Sewage Works Associations, Manual of Practice No. 3, "Municipal Sewer Ordinances."

PUMPING station has separate wet well section

PRIMARY settling unit is this Imhoff tank

Connections to Sewers

The design and construction of the "building sewers" (house connections) presented a rather difficult problem. It was felt unwise to permit each owner to construct his own building sewer since in a small community of this type many would undertake to do their own work or would hire low-priced, unskilled help to do the work. Control of the quality of the work would be difficult under such conditions. The problem was mainly difficult because the town had only a limited Public Works Department and no engineering staff. The Sewer Department was newly formed and consists of the part time services of the Waterworks Superintendent and of a full time laborer-operator to operate and maintain the sewage works.

To meet the problem the engi-

Equipment Data

Transite Building Sewers	**Johns-Manville**
Cement-asbestos pipe	Keasby & Mattison Co.
Cast-iron fittings	Hilco Supply, Inc.
Pumping equipment	Fairbanks Morse & Co.
Comminutor	Worthington Corporation
Trickling filter distributor	American Well Works
Final tank sludge collector	Hardinge Co.
Venturi meter	Simplex Valve & Meter Co.
Chlorinator	Wallace & Tiernan Co.
Electrical switchgear	General Electric Co.
Contract 1 Main Pumping Station and Sewage Treatment Plant	Samuel Aceto & Co., Portland, Me.
Contract 2 Sewers and Force Main	C. Jiustino, Inc., Roslindale, Mass.
Contract 3 Sewers	Landers and Griffin, Inc., Portsmouth, N. H.

neers prepared a form of contract and specifications for the construction of building sewers which required the contractor to make the necessary investigation for each building sewer, prepare a layout for each and present the same to the Town Manager for approval. The contractor was also required to provide his own lines and grades for construction. Measurement of quantities was so specified as to facilitate ready checking by the Town Manager of the contractor's estimates for payment for each building sewer constructed.

While the arrangement was somewhat cumbersome it has worked reasonably successfully and by December, 1953, more than 60 building sewers had been completed.

The contract for construction of building sewers was awarded to D. E. Ambrose and Sons of Meredith. The contract was on a unit price basis and provided for a minimum of 25 and a maximum of 200 building sewers to be authorized and constructed within one year of the date of the execution of the contract. The contract provided that the contractor would not be required to submit layouts for not more than 40 building sewers in any 30-day period, he would be required to complete each building sewer within 30 days following approval of the layout, but would not be required to complete more than 15 building sewers in any 30-day period.

Building sewers were constructed of 5-in. size Johns-Manville Transite House Connection Pipe furnished by the Town. Pipe fittings were furnished by the contractor.

Responsibility for the work by the Town is under the Board of Selectment who act through the Town Manager. During the course of the project there have been three Town Managers: Messrs. Gray, Rhodes, and the present manager, Mr. Ernest Libby. Direction of the work for Metcalf & Eddy has been by Mr. Frank L. Flood as partner in charge, Mr. Dean Coburn as project engineer, and Mr. Emery Doane as resident engineer. The writer was formerly project engineer and is now partner in charge.

C. C. Ruchhoft Dies

Internationally-known Section Chief Of U.S.P.H.S. San. Eng. Center

Clarence C. Ruchhoft, noted scientist and engineer with the U.S.P.H.S. at the Robert A. Taft Sanitary Engineering Center, Cincinnati, retired due to illness July 1, and died at his home in Cincinnati on January 19th.

Born in Newton, Wisconsin, March 3, 1896, Mr. Ruchhoft joined the PHS Laboratory in Cincinnati immediately after graduating in 1921 from the University of Minnesota where he received a B.S. degree in Chemical Engineering. In 1924 he left the PHS to head the Bacteriology Division of the Sanitary District of Chicago. He returned to the PHS Laboratory in Cincinnati in September, 1935, as a principal chemist and received a commission as Engineer Director in the regular corps of the PHS in 1949.

He received the Emerson Medal of the F.S. & I.W.A. awarded at the Federation's National Meeting in October. His executive and committee offices included chairmanship of the American Chemical Society's Division of Water, Sewage and Sanitation Chemistry and chairmanship of the Society's Cincinnati Section.

Mr. Ruchhoft was a member of the Society of American Bacteriologists, American Water Works Association, Central Sewage Works Association, and the Engineering Society of Cincinnati.

A. J. Reed Heads Research of Clay Pipe Association

Albert J. Reed, former Senior Research Engineer, The Carborundum Company, has been elected Director of Research of the National Clay Pipe Research Corporation, according to an announcement from Clark Sutherland, Corporation President, and D. M. Strickland, President of the National Clay Pipe Association. This is an organization of the vitrified clay pipe industry wholly engaged in clay pipe research developments, product improvement and study of health-protecting sanitary lines of clay pipe and kindred products.

Mr. Reed holds a Bachelor's Degree in Ceramic Engineering from Ohio State University. In 1943 he joined the Harbison-Walker Refractories Company, and in 1946 he joined the Carborundum Company as a Development Engineer. Two years later, he was promoted to Senior Development Engineer and was made responsible for planning and technical direction of research projects in the field of ceramic bonded abrasives. In 1952, he was again elevated, this time to the position of Senior Research Engineer, Research and Development Division.

The clay pipe industry has launched an expanded research program aimed at improving existing products and developing new clay products, all designed to broaden the industry's service to the public.

New AWWA Standards On Sodium Silicofluoride

Sodium silicofluoride—or, as it is also known, sodium fluosilicate—for the fluoridation of water supplies is the subject of a new specification approved as Tentative Standard by the American Water Works Association. The 6-page document discusses material specifications, sampling and packing, and testing methods.

Copies of the new specification are obtainable from the Association at 521 Fifth Ave., New York 17, N. Y., upon advance remittance of 20c per copy.

Controlled Humus Production

by Separate Sludge Digestion and Drying

Part 3—Process Operation and Control

by LEONARD L. LANGFORD

Mr. Langford is Eastern Sales Manager, Pacific Flush Tank Co., Port Chester, N. Y. In three comprehensive articles, he evaluates the digestion and drying of sewage sludge in terms of a manufacturing process. His paper was presented at the seventh annual meeting of the Virginia Industrial Wastes & Sewage Works Assn.

THE digestion of sewage sludge generally produces about 90 per cent of the total gas yield during the first six days. With intensive, controlled digestion, the rate of gas evolution increases rapidly to a maximum within three hours after completion of the daily charge. Forty per cent of the final volume of gas may be produced during the first twenty-four hours.[22]

Before considering details of operation and maintenance of the gas utilization system, let us note some of the theoretical considerations involved in the production of sewage gas. Given favorable conditions in terms of pH (range 6.8 to 7.2); alkalinity (range 2,000 to 3,500); temperature (range 85° F. to 95° F.); O-R potential (range —100 to —200 mv.); volatile acids (range 100 to 500 ppm, approximately); and volatile solids in the raw waste (at least 60 per cent); and barring conditions toxic to the propagation of desired organisms, the production of gas having a value of approximately 600 Btu can be anticipated, at the rate of about 9.5 cubic feet per pound of dry volatile solids added to the digester.

Operating the Digestion Process

All gas equipment should be of reputable manufacture, and manufacturers' descriptive and operating instructions should be readily at hand. It must be apparent that a careful watch of gas production, in terms of both rate and quantity, will provide a fair indication of the condition of the digesters comprising any system. This requires that the production from each digester be metered. For the protection of the meters, as much moisture as possible should be removed from the gas before it reaches them.

Gas collection, measurement, storage, use, and wasting should be carried out under conditions which will insure safety to the operators and structures. Basically what is involved is the principle of continuous and positive pressure (at least 1" water column) in all parts of the system—at all times![23]

Determination of gas pressure at several points within the gas system is important and necessary. Connecting lines to such manometers should be as short as possible and provided with unions or their equivalent. The use of low pressure check valves in the line from each digester may prevent the temporary loss of large quantities of gas, needed for power or heat.

The preparation of comparative charts on plain or graph paper is recommended. These should include records of daily gas production, outside temperature, and tank temperature. Such charts will indicate the effects of (a) storms or exceptionally low temperature; (b) interruption of raw sludge feed; and (c) loss of gas production due to toxic trade waste, or withdrawing of digested sludge in too great a quantity, or the opening of an emergency relief or sticky valve rod, etc.

It should be remembered that, for each cubic foot of sewage gas used, about six and one-half cubic feet of air are required for combustion. With this in mind, determine availability of the amount of air required for the gas-consuming devices located within the room or chamber, with all doors and windows closed. Thus, if a sludge heater, for example, has a rated consumption of 2,000 cubic feet per hour (maximum), an air requirement of about 216 cubic feet per minute for combustion alone would be indicated. The fresh air inlet should be so positioned as to reduce the tendency to create an undesirable draft through inter-connecting rooms or corridors.

Where fixed roofed tanks must be used, particular care should be exercised to: (a) prevent damaging uplift against the top; (b) maintain gas-tight conditions; and (c) prevent the possibility of the establishment of an explosive gas-air mixture within either the structures and/or the gas utilization system.[23] With floating covers less concern need be exercised relative to these matters. When gasholders are located in secondary digestion tanks, particular attention must be paid to them during freezing weather, lest their effect be that of a fixed roof.

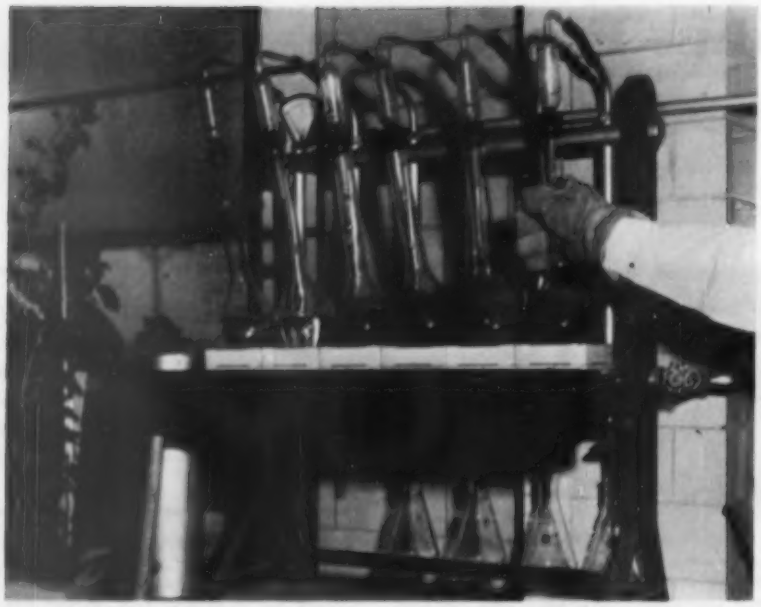
Quarterly inspection of vacuum-pressure relief devices is quite important. Periodic inspection and preventive maintenance schedules should be established and strictly adhered to; this applies to all equipment.

Good Maintenance Practices

Maintenance of studs, nuts, etc., will make for a saving of time and labor if, in an emergency, access to the digester must be quickly accomplished. Annual inspection of the gas dome area and of the steelwork of the dome above the sludge line is advisable. This operation provides an excellent opportunity to remove any undigestibles which tend to accumulate within the dome area, and to effect a tank inventory with greater ease than by the use of the smaller sampling well openings. Inspection and cleaning, if necessary, of at least that portion of the gas piping within the digester to which access can be gained, can also be accomplished at this time.

Painting is perhaps the most important job to be performed in connection with maintenance of structures and equipment. The use of "Texaco Rust Proof Compound" on submerged materials, or on parts not regularly handled and not normally subjected to temperatures of more than 95° F., is to be highly recommended.

While it is not a chore to be pleasurably anticipated, if and when it



VOLATILE ACID distillation equipment in the Lamberts Point Plant of the Hampton Roads, Va., San. Dist. Comm.

becomes necessary to empty a digester, due safety precautions should be followed, with not less than three men being in attendance. Prior to actual dewatering, washing of walls and bottom, entry into the digester should not be attempted unless absolutely necessary. The emptying of a digester, or the removal of the top of a gas dome, should not be undertaken without giving due consideration to all aspects of the work pertaining to protection of both men and structures.[18, 23]

First extinguish flames by turning to a closed position all valves in gas lines leading to gas burners. Open the sampling well hatches and the inspection hatch in the top of the cover to afford relief for the gas produced. Better yet, remove gas pipe housing and the entire top of the gas dome, which must be taken off in any event.

The inside of the digester should be hosed down as the sludge is withdrawn, using settled sewage or city water. Do this by suitable manipulation of the hose nozzle through the gas dome or through the manhole in the floating cover. After all sludge has been drawn from the tank and the latter hosed down, fill the entire tank with settled sewage or city water, sufficient to float the cover by 3 or 4 inches. This will purge the tank of any gas or gas-air mixture which might remain after the initial washing-down process.

After the water has been withdrawn from the digester, men should be able to enter the tank without danger or hazard. It would be well to have an air blower of adequate capacity available in order that fresh air might be blown into the tank if conditions require this added precaution.[18]

The Value of Records

Too much emphasis cannot be placed upon having available accurate and adequate records of operation. They may prove invaluable if difficulties arise, and may be the means of preventing costly breakdowns of the digestion process, building heating, or the power system.

In addition to records previously suggested, and as required by governing authorities, it is well to keep posted on the contributing population—equivalent in terms of: (1) solids: (a) total, (b) suspended, (c) per cent volatile and (d) removal; and (2) effect of storm flows upon digestion, as reflected in gas production, etc.

Laboratory Tests are Needed

The extent of records relating to sewage sludge digestion will depend to some degree upon the amount of laboratory work which is done with regularity. Such work should include daily, weekly, and monthly determinations. Just what these determinations are to be must be dictated by the requirements of governing bodies, and the dictates of one's conscience and interest in research.

With respect to proper operation of digesters, Hatfield suggests[24] the following tests:

(1) pH—a rapid and easy test of sludge acidity.
(2) Volatile acids—of great value where the digester is overloaded with organic matter or garbage, in particular.
(3) Solids test—total, volatile and ash, for determining the extent of digestion.
(4) Digestion gas analysis—indicating abnormally high carbon dioxide and the heat value of the gas.

An additional determination, limited to a fairly completely equipped laboratory, but bearing particularly upon sewage and sludge in all stages of treatment, is that of grease determination. As a rapid test, a method using mineral oil as an extractant has been described by Gehm.[25]

It is necessary to obtain accurate samples of the material before any tests can be run. Grab samples usually are satisfactory for running tests on raw sludge, digesting solids, sludge liquor, digested sludge or supernatant liquor. The quantity of the sample is equally important, and it is better to have to waste some than to need a little more for a check analysis. Unused samples should be properly marked and retained for a time, as it frequently happens that a duplicate test may be needed. Always record the initial temperature of the sample. When solids or fibrous materials are present, samples should be taken in a large-mouthed receptacle.

Even if there are no laboratory facilities available, it is advisable to obtain daily samples of the sludge liquor and of the supernatant liquor (if there is a secondary tank). Temperature can be measured, and a comparative solids determination can be made after two hours' settling in an Imhoff cone or a graduated flask. A pH determination is simple to make and is mandatory in many states.

An accurate record of the following items is desirable:

(1) Screenings, if disposed of by digestion, by weight of each day's accumulation.
(2) Grit, because some of it will enter the digester, by weight or volume after draining.
(3) Scum or skimmings, if disposed of by digestion, in terms of cubic feet per day.
(4) pH (hydrogen ion concentration), in accordance with "Standard Methods for the Examination of Water and Sewage"[26], or the Pennsylvania Laboratory Manual[27], of the following:

MODERN LABORATORY of the sewage treatment plant, Arlington County, Va. Chemist, M. H. Gula, is responsible for making regular laboratory tests and keeping records.

(a) raw sewage
(b) raw sludge pumped to digesters, daily or weekly.
(c) supernatant or sludge liquor returned to the plant daily or weekly
(d) digested sludge liquor, whenever such material is being vacuum filtered

(5) Total alkalinity in accordance with "Standard Methods," of supernatant and sludge liquor from all tanks in use.
(6) Total suspended solids, by "Standard Methods," on the following:
(a) raw sewage
(b) primary clarified effluent
(c) secondary clarifier influent
(d) secondary clarifier effluent
(e) supernatant or sludge liquor returned to the plant from the digestion system
(7) Ash and volatile matter.
(8) Moisture and total solids.
(9) Total volatile acids, by "Standard Methods," or by the filtration method of Heukelekian and Kaplovsky[28].

Safety Equipment Recommended

In sewage treatment plants, as in any industrial plant, protection against toxic gas vapors, dust, or oxygen deficiencies, should be taken for granted. Unfortunately, those responsible for the design and management of sewage works have not generally been as conscientious in maintaining safety standards as have the authorities in industry.

To prevent possible accidents to structures or humans, both a portable explosimeter and a portable combustible gas indicator are extremely valuable. An oxygen deficiency indicator provides an inexpensive means for determining whether the atmosphere in a confined space contains sufficient oxygen to support life. A pneolator might easily save a life under certain circumstances, as this device provides artificial respiration for a victim of asphyxia, by means of positive pressure oxygen administration, without suction. A hand-operated detector for hydrogen sulphide gas should be a "must" at every well-managed plant.

It cannot be emphasized too strongly that the chief danger at any sewage works lies in a lack of oxygen.[18] Every portion of the plant must be adequately ventilated, even when doors and windows are closed. Minimum essential safety equipment must include masks for emergency respiratory protection, and one or more indicators for testing the toxicity or explosibility of the atmosphere.

Conditioning the Final Product

From twenty to forty days after the start of controlled processing of raw sludge, a liquid humus, dark in color and having a so-called "tarry" odor, may be in suitable condition for agricultural use. The characteristics of the processed raw material at this point are as variable as were the characteristics of the raw sludge. However, it should contain approximately 50 per cent to 45 per cent of volatile matter, about 55 per cent of fixed solids, and a moisture content ranging from 97 per cent to 85 per cent.

Assuming that the grease content is not excessive, this liquid humus is ideal for direct application upon arable farm land. It is readily transported by tanks, and easily applied directly to the land. When there are no large farm areas in the immediate vicinity, or when for some other reason the use of humus in liquid form is impractical, dewatering is normally the next step. This may be accomplished by gravitational filtration and natural evaporation on sand drying beds, or by mechanical filtration and heat drying.

For the average small sewage treatment plant, open or covered sand filters have been effectively used. The ability of the filter sand to carry off drainage is a most important factor. Some sands have a tendency to pack, thus resisting the free flow of water. Sand having an effective size of 0.3 to 0.5 mm. and a uniformity coefficient less than 5 is commonly specified.[29]

I wish to express my indebtedness to Walter Kelsey, of Lord & Burnham, greenhouse designers, for much of the following technical material.

Sand bed drying of sludge involves draining, followed by evaporation, the greatest moisture reduction being accomplished by draining.

The rate of evaporation depends upon the difference in the moisture content of the sludge and of the surrounding air, the velocity of the air over the bed, and the temperature. Where the climate is frequently cold or damp, glass-enclosed beds provide a means of process control by acting as a rain shed and by providing control of ventilation.

OFFICE-LABORATORY *at a small sewage treatment plant. Note centrallization of indicating and recording devices.*

Throughout the following evaporation time, the relative humidity of the air within the enclosure, rather than the temperature, should be the determining factor in respect to the positioning of the ventilators, except that it is generally undesirable to allow the sludge to freeze. Because sunlight plays an important part in sand bed sludge drying, the masonry supporting walls should be no higher than may be required to prevent damage to side glass resulting from alternate freezing and thawing of drifted snow. Heavy shadows cast by walkways and other obstructions should likewise be avoided by a designer.

It is important to properly prepare the sand surface before applying the liquid sludge, by leveling it in such fashion as will aid the flow of sludge to the far side of the bed. In other words, slope the sand surface downward from the sludge inlet. Be sure that sand is suitably banked up against all removable division boards or gates. Whenever sand has been lost to a depth of three or four inches, it should be replaced with sand of whatever quality has been found best.

Individual beds are frequently constructed too large. They can often be reduced in area by using suitable wood or concrete planking. Redesign with respect to relocation of truckways is commonly called for. The use of an inclined, portable, powered conveyor belt will save hundreds of manhours per year.

In his excellent paper, "Measurement of Sludge Drying Bed Performance," Haseltine[30] suggests a method whereby sludge drying bed performance can be measured and compared. He indicates the relationship of temperature and the solid content of the material to be dried, as important variables, when assessing the efficiency of air drying. He further points out that the optimum depth of application of sludge for any given plant might prove to be only nine inches on open beds, but twelve to fourteen inches on covered beds. The amount of grit in the digested sludge is also referred to as a factor in the operation of sludge beds.

Vacuum Filtration of Sludge

If the final product of digestion is to be dried and salvaged for use as fertilizer base or compost ingredient, its moisture content is frequently reduced by means of a vacuum filter rather than by sand drying beds. For the brief discussion of mechanical filtration and elutriation, I am indebted in part to T. R. Komline of Komline-Sanderson Engineering Corporation.

A vacuum filter usually consists of a horizontal steel drum, supported over a vat in such fashion that about 25 per cent of the drum dips into the metal vat as it continuously revolves. To circumvent the necessity of cleaning or replacing the filter cloth, some types of filters now use coil springs of 0.410 inches in diameter. A vacuum is maintained for a large part of a revolution. Dewatered sludge cake is scraped from the filter cloth, or the flexing of the springs as they leave the vat and pass over aligning rolls aids in the discharge of a sludge cake, the moisture content of which depends upon the degree to which it has been digested and the efficiency of the chemical preconditioning, prior to its being subjected to the action of the vacuum filter.

Preconditioning of the sludge usually requires the use of a bucket elevator or sludge pump, a wet type lime slurry feeder, and mixing tank having a metered water supply. Ferric chloride as a conditioning agent can be supplied in either liquid or anhydrous form, depending upon local economy. It is important that the conditioning tank, equipped with a variable speed agitator, be located close to and approximately three feet above the filter vat sludge level. The sludge cake can readily be discharged directly onto a belt conveyor for weighing and made available to a truck, hopper, or pug mill.

While economy in the cost of conditioning agents can be effected by elutriation, or washing of sludge prior to filtration, an increase in the cost of filter equipment must be recognized. The saving in the amount of ferric chloride will, of course, more than pay for the increased capital investment required to afford protection against the more corrosive material to be filtered which results from the use of this process. Elutriation con-

ditions the sludge by reducing excessive amounts of soluble ammonia derivatives and ammonium compounds which normally inhibit coagulation. This is accomplished by successive decantations with sewage effluent or fresh water. Countercurrent elutriation is frequently advantageously used.

Summary

As the end-product of the process of sludge digestion, and in addition to its use as a fertilizer ingredient, sludge humus is of great value as a soil conditioner. "It improves the water-holding and erosion-resisting capacity of the soil and furnishes a substrate for useful soil bacteria."[31]

Unfortunately, horticulturally-minded folk have been so engrossed in increasing the rate of plant metabolism that the resultant ravages of the soil and depreciation of the food value of forage, vegetable and fruit crops have been overlooked or denied by county, state, and federal agencies. Combine the use of chemical fertilizers, poisonous sprays, and topsoil erosion resulting from deforestation, and you can appreciate why the U. S. Department of Agriculture reported some time ago that 61 per cent of the total area then under crops (253,000,000 acres) had either lost most of its crop fertility or been partially destroyed.[32]

Organic fertility can well be increased by the use of sludge humus, suitably fortified with phosphate rock (*not* superphosphate), cottonseed meal, castor pomace and other suitable organic materials. It is suggested that sewage plant operators make use of this valuable material in the suggested manner, to establish public interest in their profession and their plants, as well as to enhance the morale of all participating in that municipal activity. We, as members of the Federation, are in a position of being able to pan great quantities of "black gold," to the benefit of the Nation—let us work our claim safely and efficiently!

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W&SW

(Part 3 of three parts)

"From Sludge to Fudge" —This Chemist Knows Both

We are indebted to "The Digester" of the Illinois Health Department for the following item, quoted in full:

"J. J. Alikonis of Bloomington is best known to Illinois sewage works operators as the chemist for the Bloomington-Normal Sanitary District. Only a few may be aware that he is a person of such extreme versatility that he holds the position of Director of Research for the Paul F. Beich Company, manufacturer of candy. That his candy company job is not an unearned and empty title is attested by his present holding of the office of president of the American Association of Candy Technologists and by the announcement in June of his selection by the candy industry as the recipient of the Stroud Jordan Award for 1954 for his great contributions to the confectionery industry.

"The Illinois sewage works operators congratulate Justin J. Alikonis!"

"I have become convinced that before very long America will almost unanimously look upon water as its single greatest natural resource."—*Dwight D. Eisenhower*, President of the U. S.

Sanitary Eng. Assistantships At Washington State College

The State College of Washington has available several graduate assistantships, leading toward a master of science degree in sanitary engineering. These involve half-time research during the academic year, with full-time research during the summer.

For further information, write to Professor Emmett B. Moore, Chairman, Department of Civil Engineering, State College of Washington, Pullman, Washington.

"If you won't pay that water bill how about getting outa' that soft chair and giving me a hand."

New Book on Fluoridation as Public Health Measure

A monograph titled "Fluoridation as a Public Health Measure", has recently been published by the American Association for the Advancement of Science. The Editor is James H. Shaw of Harvard School of Dental Medicine.

Major emphasis is placed on the effectiveness of fluoridation procedure and its validity as a public health procedure. "The end result is believed to be a reasonably complete knowledge of the relation of fluoride ingestion to human health. From the data and discussions presented in this monograph, the public health worker, the civic official, the waterworks engineer or the interested layman can find the answer to the particular problems with which he is concerned." The eleven chapters, prepared by twenty eminently qualified authors, are evidence of the unbiased authenticity of the book's contents.

For copies of this book write to John A. Behnke, Assoc. Adm. Secy., Amer. Assn. for the Advancement of Science, 1515 Massachusetts Avenue, N. W., Washington 5, D. C. The price is $4.50 (to members of AAAS the price is $4.00).

ENTRANCE to new underground pumping station and . . . . . UNDERGROUND motor controls which alternate pump service

Modernizing a Sewage Pumping System

Topeka, Kansas, builds its improvement program around existing units

by D. B. KISSINGER

Mr. Kissinger is Engineer-Superintendent of Sewers, City of Topeka, Kansas. ***His paper describes how this city has developed a coordinated plan for seven sewerage systems discharging into a single treatment plant. There are 20 lift stations, equipped with 44 pumps varying in sizes and types to meet special requirements at each station.***

EMBARKED on a major program of expansion and improvement in sewage handling, the City of Topeka, Kansas, has found that its varied and extensive pumping equipment, installed over a period of 26 years, can continue to function with remarkably few additions. Some pumps which have been in service efficiently since 1928 are marked for important roles in the new system and are expected to serve indefinitely.

Topeka presently has 20 lift stations and a total of 44 pumps, the variety of pump sizes and types matching the variety of special requirements at each station. The addition of new pumping units in recent years has kept the equipment up to date and abreast of current requirements.

Rapid Population Growth

The city's principal problem through the years has been a rapid population growth which has continually outstripped both sewage treatment and collecting facilities. As a result, with the population increasing from 33,608 in 1900 to approximately 100,000 today, disposal facilities have lagged far behind the demand, and more and more raw sewage has been discharged directly into the Kansas River. Many districts found it necessary to combine both storm and sanitary sewage lines, further aggravating the situation.

Another complicating factor was the shift in population caused by the flood of 1951, the largest and worst on record. For every home this flood swept away north of the Kansas River, where most of the devastation was centered, a dozen or more homes were constructed to the south and west, the highest portions of the city. This placed unprecedented strains on existing sewers and forced the construction of new trunk lines into outlying areas.

Meanwhile, the Air Force reactivated and expanded its base at Forbes Field, four miles south of the city limits, giving impetus to the building boom. New houses became necessary to house both temporary and permanent personnel at the base, and the problem of providing adequate sewage facilities for the increased population became even more pressing. Between 1950 and 1952 the population jumped from 78,791 to an estimated 92,304, an increase of 12.1 per cent in only two years.

Sewerage System Expansion

To meet these challenges, and also to comply with the provisions of a recent State Board of Health directive which restricted further pollution of state waters and condemned the use of combined storm-sanitary sewers, the City of Topeka has undertaken an extensive $3,000,000 modernization and ex-

pansion program, calling for the laying of more than 16 miles of relief sewer and the construction of two new lift stations. A third lift station is to be remodeled and increased in capacity.

The effect of this new program will be to coordinate the seven individual sanitary systems now serving the city within a single "master plan" of interconnecting sewers, to discharge all raw sewage into the municipal disposal plant, which is presently being expanded from a capacity of 8.5 to 20 mgd. This will end all normal discharge of untreated sewage into the Kansas River and connecting waters.

FLOOD STATION in residence neighborhood
The right end is attendant's home; the left houses three pumps.

Existing Pumping Units

The six new sewage and trash pumps called for in the program are few in number, considering the overall extent of the $3-million project and the length of service of some of the 36 existing pumps. Certain pumps date back to 1928, and are veterans of such extraordinary heavy duty as the 1951 flood, one of the world's all-time worst.

After the shock of the 1951 flood, the only special attention needed by the 39 Fairbanks-Morse pumps included in the system was to take each one down and give it a good cleaning. Even this was not done in the case of one old pump which was needed immediately for emergency use. Operators simply flushed it out, gave it an oil bath and put it back to work. It has been running smoothly ever since.

Another pump which saw extraordinary service during the 1951 flood was a 1200 gpm vertical close-coupled unit at the Oakland station. Lowered down into the station's wet well by means of a chain hoist, this pump was operated while suspended on the chain and used to pump down the Oakland sewers several days before it would otherwise have been possible, an emergency measure which helped minimize the flood damage in that area.

All 39 Fairbanks-Morse sewage and trash pumps are of the non-clog type, thirteen of them featuring the F-M bladeless impeller, a special single-passage design which handles fibrous material up to 25 times the size handled by conventional-type impellers.

Non-clog design permits most pumps in the system to operate without suction caps. Suction caps were more the rule than the exception until two years ago. At that time all 36 pumps in 16 lift stations were equipped with caps or screens, each cap having to be pulled and cleaned at least once a week—a nasty, time-consuming job. To cut down on this time loss, the caps on 16 of the pumps were eliminated, the non-clog features of the F-M units being depended upon to keep them running smoothly. In the first year of operation under this procedure only a few cloggings were reported, the remaining pumps behaving as well without the caps as they did with them. Hundreds of man-hours will be saved each year in this way.

Eleven Underground Pump Stations

The head illustration shows one of eleven underground sewage pump stations, equipped with a total of twenty-two vertical, close-coupled, Fairbanks-Morse pumps. These pumps have been added to the Topeka sewage system in recent years, facilitating expansion into outlying areas and cutting construction costs to a minimum. They are highly compact, fully automatic units manufactured by Smith & Loveless, Inc., of Kansas City, Mo., and are shipped as a complete factory-built product ready for installation. It is necessary only to lower the station in place, make the piping connections, and the station is ready for operation.

Each unit consists of a standard pump chamber and entrance tube. The pump chamber is a welded, water-tight steel tank which includes two vertical, close-coupled, non-clog sewage and trash pumps complete with motors, electrical control panel with circuit breakers, magnetic starting equipment, control switches, lights, steel ladder, all pipe fittings and valves, sump pump, a motor driven ventilator and refrigeration type dehumidifier which keeps the station dry.

The underground station located on Gage Boulevard in the Westview Heights Manor development of southwestern Topeka is typical of the eleven underground stations. It is equipped with two 4-in. vertical, close-coupled Fairbanks-Morse sewage and trash pumps, each having a bladeless impeller and delivering 500 gpm at a head of 35 feet. The stuffing boxes on these pumps are equipped with double mechanical seals. These seals are kept dead tight by high pressure fluid from a specially designed hydraulic system which prevents sewage gases from entering the pump station and eliminates the usual stuffing box maintenance.

The 7½ HP, 1750 rpm Fairbanks-Morse motors driving these pumps are started and stopped by air purge type controllers actuated by the sewage level in the wet well. To distribute wear, the motors are operated alternately by means of an automatic sequence changer. In this way the pumps receive equal usage, even in the absence of a regular attendant. In fact, the only supervision required is a daily check by a roving operator. Two operators take care of all pump stations.

Main Lift Station

The main lift station in the Topeka system is the four-pump Ash Street station, located at the terminus of the Crane Street interceptor in the northeastern part of the city. The bulk of the sanitary sewage collected south of the Kansas River, contributed by a population of about 85,000 people, flows through this station and is pumped through a 30-inch force main to the municipal treatment plant.

The Ash Street station was built

POWER UNITS in Quincy Street flood station
Engine-operated 15,000 gpm propeller pump and motor-operated 5,000 gpm turbine pump.

in 1928 and is equipped with four vertical Fairbanks-Morse sewage and trash pumps (see illustration), having a combined rating in excess of 21,200 gpm. Variable-speed, slip-ring motors, governed through a 12-step automatic control system (see illustration), enable three of these pumps to hold the level in the wet well within a 36-in. differential. In rainy weather, when the flood gates remain open, the overflow from the system is by-passed directly to the river. When the flood gates are closed, a fourth pump, rated at more than 10,000 gpm, is used to pump the overflow to the river.

This 10,000 gpm sewage pump normally operates at a head of 47.5 feet. It has a 12-in. discharge line and is driven through a solid 35-ft. vertical shaft by a 150-hp 450 rpm F-M motor. It was originally installed in 1928 and is one of the oldest units in the system. Its primary function in the new system will be to increase the station's capacity to deliver sewage to the treatment plant. The fact that it has been retained in a key position after 26 years of service is indication of its continued efficiency.

Ash Street Station

Another interesting pump at the Ash Street station is a 4700 gpm F-M unit which is of the same size and type, operates at the same head and is driven by the same electric motor as a 3700 gpm unit it recently replaced. The larger-capacity pump is identical in every respect to its predecessor, with the single exception of its impeller design. The new design is of the latest type developed by Fairbanks-Morse and raised its rated capacity by 1000 gpm. A 10-in. centrifugal pump, it operates against a head of 46 feet and is driven through a solid 35-ft. vertical shaft by a 75-hp, 600 rpm F-M induction motor. It will pass 8-in. spheres without clogging.

The two remaining pumps at the Ash Street station are rated at 3000 and 3500 gpm respectively, both operating against total dynamic heads of 45 feet. The 3000 gpm unit has a discharge diameter of 8 in. and is driven through a vertical shaft by a 40-hp F-M induction motor. The 3500 gpm unit has a discharge diameter of 10 in. and is driven through a similar shaft by a 50-hp 700 rpm F-M motor. The larger unit was installed in 1940; the smaller in 1948.

The combined capacity of these four pumps exceeds the 20 mgd capacity of the municipal treatment plant and will be more than sufficient to handle the increased flow expected from the Crane Street interceptor when the present expansion program is completed. At that time the 42-in. reinforced-concrete interceptor, lined with vitrified-clay blocks, will be increased from its present length of about one mile along the south bank of the Kansas River to almost four miles. A new Shunganunga interceptor, with branches extending far into the south and southwest portions of the city, will be constructed for a distance of about 10½ miles from the station. No replacements or additions to the present pumping equipment will have to be made to handle these increased loads.

Interceptor Costs $2 Million

The Shunganunga Creek interceptor and its branch-like sewers throughout the south and southwest portions of the city constitute the largest combined item in the program, to be built at an estimated cost of close to $2,000,000. When completed, it will also intercept the old Jefferson Street and Chandler Street systems in the east and will virtually end the overflow of storm and sanitary sewage into the Shunganunga Creek, a source of great public health nuisance in the past.

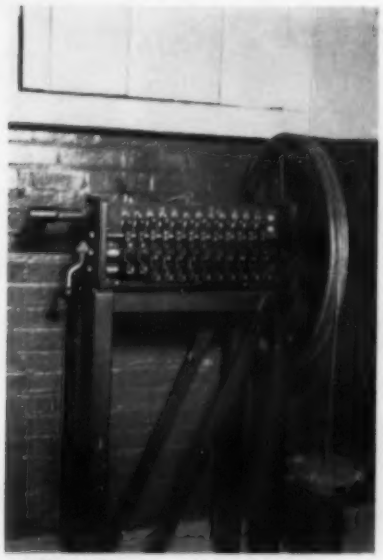
To help handle the increased flow expected in these lines, which are designed to extend beyond the city limits in the direction of Forbes Field, the city is planning to increase the pumping capacity of its Central Park station and to remodel the station building.

At present the Central Park station is equipped with two horizontal Fairbanks-Morse sewage pumps, one rated at 375 gpm and the other at 600 gpm, both operating against a head of 25 ft. and discharging to an 8-in. force main. When the new sewage lines are completed, the 375 gpm pump will be replaced by a 1400 gpm unit and the existing force main replaced with one of 16-in. diameter. The building boom going on in the surrounding area is so intense, however, that these increases are expected to be only temporary. Further extension, including the construction of a new and larger pumping station, will probably be necessary in a few years time, according to the engineering study on which the program is based.

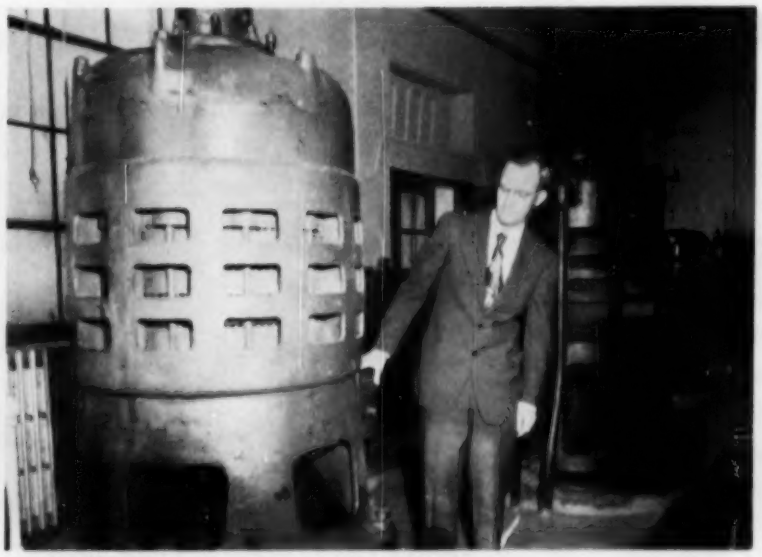
The Shunganunga interceptor will lead directly into the Ash Street station where its flow will join that from the Crane Street interceptor, being pumped through a 30-in. force main to the municipal disposal plant.

Sewage Plant Pumping

At the treatment plant, the raw sewage from both sources will join that from the Oakland system to the east and will be picked up by two existing F-M pumps, one of 750 gpm and the other of 1200 gpm capacity. These two non-clog pumps, designed to lift the sewage from the wet well to the primary settling tanks, are relatively new in the system, compared to the veterans already discussed. The smaller pump, installed in 1943, is a horizontal 4-in. sewage pump op-



AUTOMATIC pump selector unit
controls speed of three motors



ASH STREET station, main lift station in Topeka's system
Four motors drive non-clog pumps, one in service 26 years.

erating at a head of 45 feet, driven through a horizontal shaft by a 15-hp, 1150 rpm F-M induction motor.

The larger pump, delivering 1200 gpm against a head of 45 ft. is a 5-in. vertical close-coupled unit, driven by a 25-hp, 1750 rpm F-M motor. Installed just before the 1951 flood, this pump is the one used (suspended on a chain) to pump down the Oakland sewers during the height of the disaster. It is operating as smoothly and as efficiently today as it ever did.

Flood Pumping Stations

The Topeka Avenue building is a high-capacity flood station, installed in that area's storm sewer system, and is equipped with three propeller-type Fairbanks-Morse pumps, rated at 4500 gpm, 7500 gpm and 15,000 gpm, respectively. These powerful units are "tenants" in half of the building while a department employee and his family are housed in the other half. The outward appearance of the building is such that no passerby would guess that sewage pumps also "lived" there.

The Topeka Avenue flood station pumps down the area's storm sewers and discharges directly into a nearby creek. Operating quietly and efficiently, the three Fairbanks-Morse propeller pumps handle this assignment with a minimum of fuss.

The smallest of these flood pumps is a 12-in., 2-stage unit, rated at 4500 gpm and driven through a vertical shaft by a 50-hp, 1760 rpm, 2200 volt F-M motor. The second is also a 2-stage unit, having a 16-in. discharge and a capacity of 7500 gpm. It is driven through a similar shaft by a 75-hp, 1160 rpm, 2200 volt F-M motor. The third and largest pump is a 20-in. single-stage unit, delivering 15,000 gpm and driven by a 125-hp, 1160 rpm, 2200 volt F-M motor. All three were installed at the time the station was constructed, in 1938-1939.

Another flood station in the city's storm water system is the Quincy Street station (see illustration) located on the south bank of the Kansas River. Pumping directly through the levee when the flood gates are closed, this station's pumping requirements differ essentially from those of any other station, calling for the installation of two distinct types of Fairbanks-Morse pumps to do the job.

One of these is a 16-in., oil-lubricated turbine pump, rated at 5000 gpm and driven through a vertical lineshaft by a 40-hp, 220/440 volt motor. When this pump is in operation, a solenoid oiler feeds a predetermined quantity of oil into the top of the shaft tube, providing efficient, trouble-free lubrication for all working parts. One of the turbine pump's distinct advantages is the minimum amount of floor space it requires, despite its large capacity.

The second pump chosen for the Quincy Street station is a 24-in. propeller pump, having a capacity of 15,000 gpm and driven through a Universal right-angle gear and Twin-Disc clutch by a 180-hp, 1750 rpm Waukesha engine. The gears reduce the pump's shaft speed to 700 rpm in normal operation and the engine provides protection against electric power failure. Designed for large-capacity, moderate-head service, the pump is ideal for emergency duty, requiring no priming and being ready at all times for instant operation.

A useful emergency pump included in Topeka's expanding system is a 3-in. 200 gpm semi-portable, or "floater," pump equipped with an F-M bladeless impeller to widen its field of application. Driven by a 2-hp, 110/220 volt F-M motor, it is a vertical close-coupled unit operating at a head of 24 feet. When needed, it can be used almost anywhere.

Topeka's experience over the past 26 years is a tribute to the durability and flexibility of the city's pumping equipment. Today, the pumps are being groomed for even greater service.

Master plans for Topeka's sewer expansion program were drawn by the firm of Black and Veatch, consulting engineers, of Kansas City, Missouri. Construction plans for sewer expansion and the disposal plant expansion were drawn by the firm of Servis-Van Doren & Hazard, consulting engineers, of Topeka, with the co-operation of City Commissioner C. Madison Williams, in charge of all sewerage affairs; Thomas H. Bruce, Acting City Engineer; and the author.

Biological Waste Treatment Conference Program

April 13-15, Manhattan College, New York

A comprehensive group of technical papers has been arranged for a three-day Conference on Biological Waste Treatment to be presented by the Civil Engineering Dept., Manhattan College, New York, N. Y. The preliminary program of papers and authors as listed is complete except for minor changes.

The program is divided into four sessions, of which several will be concurrent:

A. Theory and Mechanism of Biological Waste Treatment—Wednesday morning and afternoon and Thursday morning.

B. Aeration Theory and Design—Thursday morning and afternoon.

C. Sewage Treatment Design—Friday morning and afternoon.

D. Industrial Wastes Treatment Design—Friday morning and afternoon.

For further details address W. W. Eckenfelder, Asst. Prof. of Civil Engineering, Manhattan College, New York 71, N. Y.

Wednesday, April 13

SESSION A

Theory and Mechanism of Biological Waste Treatment

Principles of Biological Oxidation.....
Sam R. Hoover and Mandor Porges
Biological Oxidation of Organic Wastes.....
W. W. Eckenfelder and Roy F. Weston
Nutrition and Synthesis.....*Clair N. Sawyer*
Biological Flocculation.....*Ross E. McKinney*
Mechanism of Dispersed Growth Aeration.....
Nelson L. Nemerow and John Ray
Preliminary Investigations on the Effect of Oxygen Tension on Biological Sewage Treatment.....*Daniel A. Okun and Walter R. Lynn*
Oxygen Supply the Limiting Factor in Sludge Purification.....*A. Pasveer (Read by H. Heukelekian)*

Thursday, April 14

Factors Affecting Process Efficiency, Nutrient Requirements, Sludge Production and Oxygen Utilization.....*K. Wuhrman (Read by Gail P. Edwards)*
Organic Absorption and Oxidation.....*Charles E. Renn*
Biological Processes in Waste Treatment.....
David B. Smith and James Lackey
Application of the Logarithmic Equation in Biological Oxidation.....*H. E. Orford*

SESSION B

Aeration-Theory and Design

Mechanism of Oxygen Absorption.....*Charles E. Carver, Jr.*
Some Theoretical Aspects of Aeration.....*William E. Dobbins*
Aeration and Oxygen Transport—Basic Considerations.....*Elmer L. Gaden, Jr.*
Evaulating Proprietary Aerating Devices.....*R. Ruppert Kountz*
Mechanical Air Dispersion for Sewage and Waste Treatment.....*A. A. Kalinske*
Aeration of Biological System Using Mixing Impellers.....*J. Y. Oldshue*
Theory and Development of Aeration Equipment.....
J. Donald Walker, John R. Sperry and Douglas Dreier

SESSION C

Sewage Treatment Design

Rational Approach to the Design of Activated Sludge Plants.....*T. R. Haseltine*
The Utilization of the Kinetics of Activated Sludge in Process and Equipment Design.....*A. A. Kalinske*
Comparative Economics of Trickling Filters and Activated Sludge Systems.....*Carl Arenander and Walter McPhee*
Effect of B.O.D. Loadings on Activated Sludge Plant Operation.....*W. E. Budd*
Comparative Studies of Various Modifications of the Activated Sludge Process.....*John D. Frame*
Some Aspects Affecting Biological Oxidation for Domestic Sewage.....*John W. Hood*
Final Clarifiers and Clarifier Mechanisms.....*Clair N. Sawyer*

SESSION D

Industrial Waste Treatment Design

Activated Sludge at High Temperatures and High pH Values.....*Harry W. Gehm*
Evaluation of Pilot Plant Studies and Design of Waste Treatment for the Pulp and Paper Industries.....*Theodore L. Moore and Edwin A. Kass*
Dairy Waste Oxidation Plant Design.....*R. Ruppert Kountz*
Biological Treatment of Dairy Wastes.....
H. D. Harding and H. A. Trebler
Evaluation and Design of Biological Treatment Facilities for Pharmaceutical Wastes.....
F. E. Dryden, P. A. Barrett and J. C. Kissinger
Biological Oxidation of Cannery Wastes.....
W. W. Eckenfelder and Edward Grich
Biological Treatment of Refinery Wastes.....
Roy F. Weston and Robert Baker

Norman J. Howard Retires as Head of Toronto Laboratories

Norman J. Howard, director of the water and sewage laboratories of Toronto, Ont., Canada, has retired after having served the city for 43 years. He is recognized throughout the world as an authority on water purification and sewage treatment problems.

Mr. Howard was born in England and educated at Xaverian College and the University of London. In 1907 he became associated with the Metropolitan Water Board of London, working with Sir Alexander Houston, one of the pioneers in chlorination practice. Mr. Howard came to Canada in 1911 and for a time was bacteriologist in charge of the water-filtration laboratory at Toronto, later becoming director of water purification for the city.

When the city built the new Ashbridge's Bay sewage-treatment plant, Mr. Howard headed the laboratory at the plant, and when the Municipality of Metropolitan Toronto came into existence on January 1st, 1954, he was named director of water-purification and sewage-treatment laboratories for the new municipality.

Mr. Howard has made many valuable contributions to engineering literature. He is very active in a number of technical societies. In 1928 he served as chairman of the water-purification division of the American Water Works Association, and in 1940-41 as president of the Association. In 1943 he was the recipient of the Association's Fuller Memorial Award, and in 1952, he was made a honorary member. He is also a fellow of the Canadian Institute of Chemistry.

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2. The equipment used to introduce air to the sewage. The use of Swing Diffusers and Precision Diffuser Tubes permits easy access to the grit hopper and cleaning of the diffuser media without taking the tank out of service.

*The application of the equipment, as well as the equipment itself is covered by U.S. Patents No. 2,532,457, No. 2,144,385, No. 2,328,655 and No. 2,555,201.

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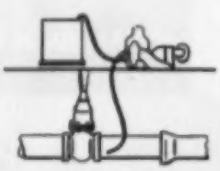

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W & SW

Meetings Scheduled

Mar. 16-18—Baton Rouge, La. *(Louisiana State University)*
WATER & SEWAGE WORKS SHORT COURSE (18th Annual). Director, John H. O'Neill, Div. Public Health Eng., Dept. of Health, New Orleans, Pa.

Mar. 17—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Mar. 18—Trenton, N. J.
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (1 day meeting). Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Mar. 21-23—Savannah, Ga. *(DeSoto Hotel)*
SOUTHEASTERN SECTION A.W.W.A. Sec'y, N. M. de Jarnette, 245 State Office Bldg., Atlanta, Ga.

Mar. 21-22—Fayetteville, Ark. *(Univ. of Arkansas, College of (Engineering)*
ARKANSAS WATER & SEWAGE CONFERENCE. Sec'y, Harrison Hale, Southern State College, Magnolia, Ark.

Mar. 22-23—Baton Rouge, La. *(Louisiana State Univ. Campus)*
FOURTH ANNUAL WATER SYMPOSIUM. Ass't. Director, Frank T. Carroll, Jr., Louisiana State Univ., Baton Rouge, La.

Mar. 31-Apr. 1—Durham, N. C. *(Duke University)*
FOURTH SOUTHERN MUNICIPAL & INDUSTRIAL WASTES CONFERENCE. Director, Prof. J. W. Williams, Head, Dept. Civil Engineering, Duke University, Durham, N. C.

Apr. 13—Bangor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Robert H. Hess, City Building, Wichita, Kans.

Apr. 13-15—Hutchinson, Kans. *(Baker Hotel)*
KANSAS SECTION A.W.W.A. Sec'y, H. W. Bradley, 119 West Cloud, Salina, Kans.

Apr. 13-15—Lincoln, Neb. *(Cornhusker Hotel)*
NEBRASKA SECTION A.W.W.A. Sec'y, E. Bruce Meier, Univ. of Nebraska, Lincoln, Neb.

Apr. 13-15—New York, N. Y. *(Manhattan College)*
CONFERENCE ON BIOLOGICAL WASTE TREATMENT. Chairman, W. W. Eckenfelder, Ass't. Prof. of Civil Engineering, Manhattan College, New York 71, N. Y.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SECTION A.W.W.A. Sec'y, Q. M. Mees, Univ. of Arizona, 721 N. Olsen Ave., Tucson, Ariz.

Apr. 14-16—Chandler, Ariz. *(San Marcos Hotel)*
ARIZONA SEWAGE & WATER WORKS ASSOCIATION. Sec'y, Quentin M. Mees, 721 N. Olsen, Tucson, Ariz.

Apr. 18-20—Quebec, Can. *(Chateau Frontinac)*
CANADIAN SECTION A.W.W.A. Sec'y, Dr. A. E. Berry, Dept. of Health, Parliament Buildings, Toronto, Ont., Can.

Apr. 20-22—Buffalo, N. Y. *(Statler Hotel)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand Street, White Plains, N. Y.

Apr. 21—Boston, Mass. *(Statler Hotel)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Apr. 27-30—Riverside, Calif. *(Mission Inn)*
CALIFORNIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, J. C. Mallery, 4822 Dunsmore Ave., LaCrescenta, Calif.

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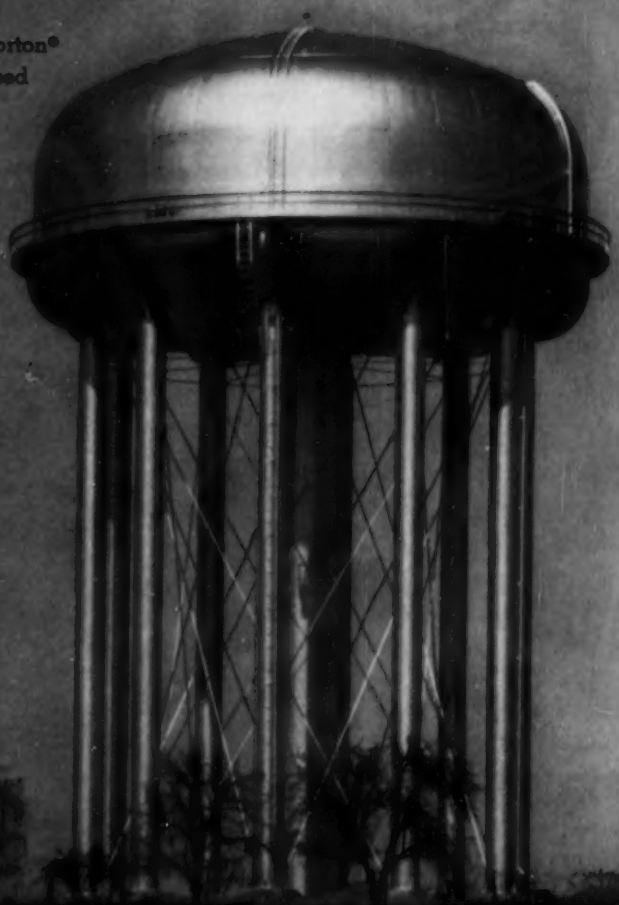

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Apr. 28—Butte, Mont. *(Finlen Hotel)*
MONTANA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Harry W. Taylor, Morrison & Maierle Inc., Helena, Mont.

Apr. 29-30—Butte, Mont. *(Finlen Hotel)*
MONTANA SECTION A.W.W.A. Sec'y, A. W. Clarkson, State Dept. of Health, Helena, Mont.

May 4-6—Pittsburgh, Pa. *(Hotel Webster Hall)*
PENNSYLVANIA SECTION A.W.W.A. Sec'y, L. S. Morgan, State Dept. of Health, Greensburg, Pa.

May 9-11—Lafayette, Ind. *(Purdue University)*
TENTH PURDUE INDUSTRIAL WASTE CONFERENCE. Director, Professor Don E. Bloodgood, Purdue University, W. Lafayette, Ind.

May 10—Newark, N. J. *(Hotel Essex)*
NEW JERSEY SECTION AMER. INST. OF CHEMICAL ENGRS. (Symposium featuring control of stream pollution). John N. Whelan, E. I. DuPont de Nemours & Co., Parlin, N. J.

May 19-21—Yakima, Wash. *(Chinook Hotel)*
PACIFIC NORTHWEST SECTION A.W.W.A. Sec'y, F. D. Jones, Room 305, City Hall, Spokane, Wash.

May 25—Trenton, N. J. *(Tentative)*
NEW JERSEY SECTION A.W.W.A. (Summer Outing). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

June 8—Bar Harbor, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

June 12-17—Chicago, Ill.
AMERICAN WATER WORKS ASSOCIATION. (75th Annual Convention). Exec.-Sec'y, Harry E. Jordan, 521 Fifth Avenue, New York 17, N. Y. (All reservations being cleared through A.W.W.A. office.)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW YORK SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, R. C. Sweeney, 21 No. Broadway, White Plains, N. Y.
(joint meeting with)

June 13-14—Albany, N. Y. *(Hotel Ten Eyck)*
NEW ENGLAND SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, Stephen M. Hurley, Jr., 331 State Office Bldg., Providence, R. I.

June 22-24—Columbus, O. *(Deshler-Hilton Hotel)*
OHIO SEWAGE & INDUSTRIAL WASTES TREATMENT CONFERENCE. Sec'y, Ward E. Conrad, 301 Ohio Departments Building, Columbus, O.

Aug. 15—Richmond, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION. Sec'y, R. Rupert Kountz, Penn. State University, State College, Pa.
(joint meeting with)

Aug. 22-24—State College, Pa. *(College Dormitories)*
PENNSYLVANIA SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, B. B. Bush, State Dept. of Health, Kirby Health Center, Wilkes Barre, Pa.

Sept. 7-9—Saranac, N. Y. *(Saranac Inn)*
NEW YORK SECTION A.W.W.A. Sec'y, Kimball Blanchard, 56 Grand St., White Plains, N. Y.

Sept. 7-9—Fort Dodge, Ia. *(Hotel Waukonsa)*
IOWA SEWAGE WORKS ASSOCIATION. Sec'y, L. F. Skorczeski, 207 South 15th Ave., Marshalltown, Ia.

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE INDUSTRIAL WASTES & SEWAGE WORKS ASSOCIATION. Sec'y, S. Leary Jones, 420 Sixth Ave., Nashville, Tenn.

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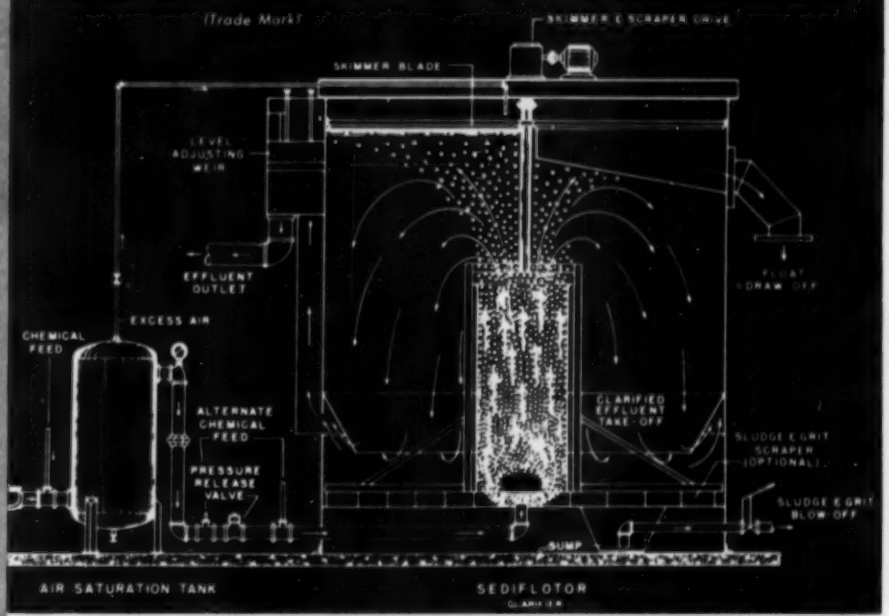

1. "DISSOLVED-AIR FLOTATION" assures rapid removal of suspended material from waste waters. Here is new efficiency for removing contaminants such as oils, greases, light fibrous materials, etc. Based on the principle of "dissolved-air flotation"—and incorporating reliable chemical feed and operating control, the "SEDIFLOTOR" Clarifier is the answer to many waste problems.

2. GRAVITY-SETTLING CLARIFICATION is included. "SEDIFLOTOR" Clarifier design provides the most modern type of gravity-settling equipment, so that both light and heavy materials are removed rapidly and effectively.

Faster...flexible...economical...dependable

Proved by exhaustive test, "SEDIFLOTOR" Clarifier offers marked advantages. The combination of flotation and gravity-settling results in extremely fast and efficient cleansing of waste waters from refineries, packing houses, paper mills, sewage plants (where large amounts of grease and oil are present), chemical and food plants and other similar sources.

It is readily adaptable for use with other equipment, and may be designed for literally any desired flow, with provisions for use of chemical agents, and continuous removal of floating scum and settleable solids.

Quite automatic, the "SEDIFLOTOR" Clarifier operates with maximum economy and requires only periodic attention.

Waste Samples Invited

Our laboratory is equipped to test samples of waste water to determine suitable methods and proper size of equipment for your needs. Your inquiry is invited and should include general description of your problem.

INFILCO

The one company offering engineered equipment for all types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment.

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Field offices in principal cities in North America

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CHEMICAL Fire and RUST PROOFING corp.

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Hotel Breslin

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- modern, restful rooms with private bath
- delightful dining room
- Cocktail Lounge
- Garage
- the thrill and excitement of all

New York

One block off Fifth Avenue, Broadway at 29th Street

Write to Hotel Breslin for FREE New York City Map

Sept. 12-14—Lexington, Ky. *(Phoenix Hotel)*
KENTUCKY-TENNESSEE SECTION A.W.W.A. Sec'y, J. Wiley Finney, Jr., 553 S. Limestone St., Lexington, Ky.

Sept. 14-16—Flint, Mich. *(Durant Hotel)*
MICHIGAN SECTION A.W.W.A. Sec'y, T. L. Vander Velde, State Dept. of Health, Lansing, Mich.

Sept. 18-22—Lake Placid, N. Y. *(Lake Placid Club)*
NEW ENGLAND WATER WORKS ASSOCIATION. Sec'y, Jos. C. Knox, 204 Tremont Bldg., Boston, Mass.

Sept. 21-23—Columbus, O. *(Neil House)*
OHIO SECTION A.W.W.A. Sec'y, M. E. Druley, Dayton Power & Light Co., Wilmington, O.

Sept. 21-23—Milwaukee, Wis. *(Hotel Schroeder)*
WISCONSIN SECTION A.W.W.A. Sec'y, Leon A. Smith, City Hall, Madison, Wis.

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
FEDERATION OF SEWAGE & INDUSTRIAL WASTES ASSOCIATION. (Annual Meeting). Sec'y, W. H. Wisely, 325 Illinois Bldg., Champaign, Ill.

(joint meeting with)

Oct. 10-13—Atlantic City, N. J. *(Ambassador Hotel)*
NEW JERSEY SEWAGE & INDUSTRIAL WASTES ASSOCIATION. Sec'y, M. S. Kachorsky, P. O. Box 766, Manville, N. J.

Oct. 12—Norridgewock, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

Oct. 16-19—San Antonio, Tex. *(Gunter Hotel)*
SOUTHWEST SECTION A.W.W.A. Sec'y, Leslie A. Jackson, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 19-21—Des Moines, Ia.
IOWA SECTION A.W.W.A. Sec'y, H. V. Pedersen, Municipal Bldg., Marshalltown, Ia.

Oct. 20-21—Clarksburg, W. Va. *(Waldo Hotel)*
WEST VIRGINIA SECTION A.W.W.A. Sec'y, Harry K. Gidley, State Dept. of Health, Charleston, W. Va.

Oct. 20-22—Atlantic City, N. J. *(Madison Hotel)*
NEW JERSEY SECTION A.W.W.A. (Fall Meeting). Sec'y, C. B. Tygert, Box 178, Newark, N. J.

Oct. 24-28—New York, N. Y. *(Hotel Statler)*
AMERICAN SOCIETY OF CIVIL ENGINEERS. (Annual Meeting). Sec'y, Wm. N. Carey, 33 West 39th St., New York, N. Y.

Oct. 25-28—Sacramento, Calif. *(Senator Hotel)*
CALIFORNIA SECTION A.W.W.A. Sec'y, Henry F. Jerauld, 1040 Manzanita, Pasadena, Calif.

Oct. 26-28—Washington, D. C. *(Hotel to be announced)*
CHESAPEAKE SECTION A.W.W.A. Sec'y, Carl J. Lauter, 6955—33rd St., Washington, D. C.

Oct. 30-Nov. 2—Biloxi, Miss. *(Buena Vista Hotel)*
ALABAMA-MISSISSIPPI SECTION A.W.W.A. Sec'y, Charles W. White, 537 Dexter Ave., Montgomery, Ala.

Nov. 3-5—Richmond, Va. *(Jefferson Hotel)*
VIRGINIA SECTION A.W.W.A. Sec'y, J. P. Kavanagh, 213 Carlton Terrace Bldg., Roanoke, Va.

Nov. 6-9—Orlando, Fla. *(Hotel to be announced)*
FLORIDA SECTION A.W.W.A. Sec'y, Harvey T. Skaggs, P.O. Box 2328, Jacksonville, Fla.

Nov. 14-16 *(Place not selected)*
NORTH CAROLINA SECTION A.W.W.A. Sec'y, Wilber E. Long, Jr., 1615 Bickett Blvd., Raleigh, N. C.

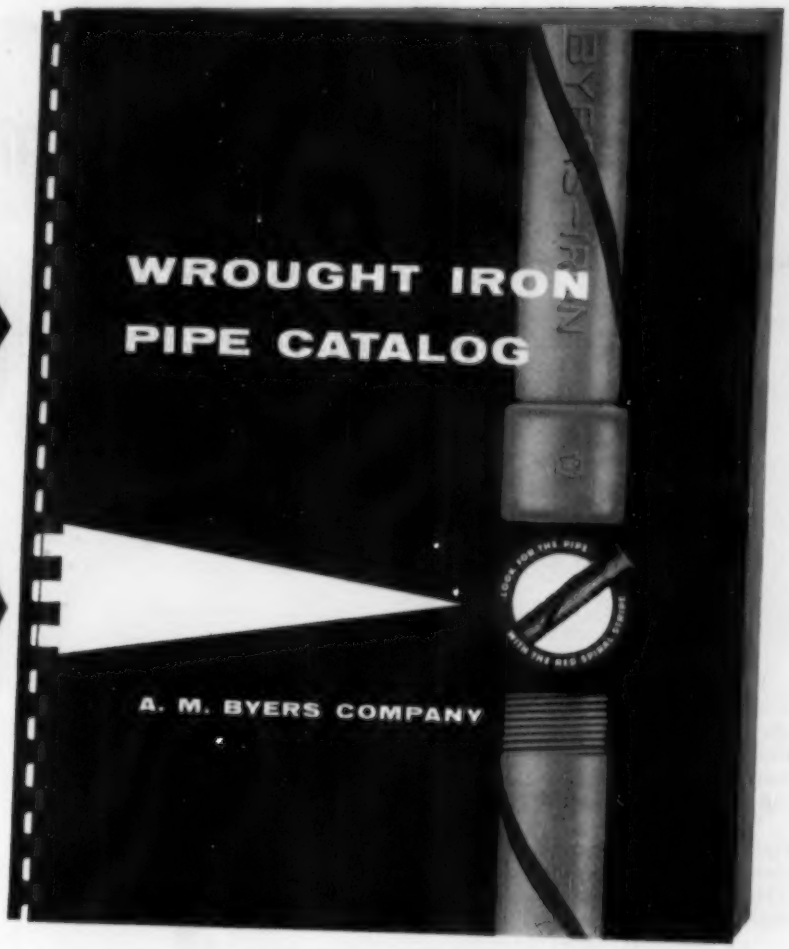
Nov. 14-18—Kansas City, Mo. *(Municipal Auditorium)*
AMERICAN PUBLIC HEALTH ASSOCIATION (83rd Annual Meeting). Exec.-Sec'y, Dr. Reginald M. Atwater, 1790 Broadway, New York, N. Y.

Dec. 14—Augusta, Me.
MAINE WATER UTILITIES ASSOCIATION. Sec'y, Earle A. Tarr, 15 Bowdoin St., Winthrop, Me.

NEW!

WROUGHT IRON PIPE CATALOG

. . . Complete facts and figures



The NEW Byers Wrought Iron Pipe Catalog wraps up between covers complete facts and figures on wrought iron pipe and tubular products.

You'll find:

. . . information on the characteristics of wrought iron and why it resists corrosion and vibration longer

. . . a complete section on wrought iron's physical properties

. . . detailed instructions on how to specify plus a list of wrought iron standards and specifications

. . . proper ordering methods so you get exactly what you want for the job

. . . general notes on mill standards

. . . complete tables on every type of wrought iron pipe, conduit, cold drawn tubing, with detailed data on sizes, dimensions, weights, mill test pressures

. . . helpful tables on decimal equivalents for calculating; dimensions of pipe in fractions of an inch; conversion factors

Important, too, is the organization and arrangement of this material. The catalog's format makes charts and tables easy to find, easy to read and follow. You'll like the way the plastic spiral binding keeps the catalog flat while you use it . . . important with a 52 page catalog.

Your copy is ready. Write for it today!

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y.

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BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY STEEL PRODUCTS

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

W&SW

New Equipment

New "Torque-Flow" Solids Pump

301

Western Machinery Company, San Francisco, California, has developed the Wemco Torque-Flow Pump that incorporates a new principle of dynamic solids pumping that eliminates the conventional impeller.

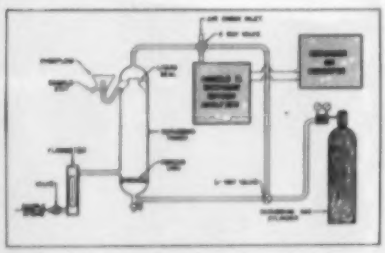
This unique materials moving principle involves the use of an impeller similar to an automobile fluid drive. The impeller, though entirely out of the material flow pattern, induces a vortex (swirl) that does the pumping. The rotating fluid mass forms a buffer between the impeller and the solid particles and chunks in the flow, so that few of them ever touch. The location of the impeller out of the main flow path insures unobstructed passage of any liquid-solid combination that will pass through the piping itself and thus eliminates any possibility of clogging. Under all conditions, impeller wear may be reduced by many times as compared to conventionally designed pumps.

Membrane Filters For Coliform Determination

302

Carl Schleicher & Schuell Co., Keene, New Hampshire, has announced the availability of "Bac-T-Flex" green grid flexible membrane filter for the filtration of bacteria, and other microorganisms.

These filters can be used for the determination of numbers and types of bacteria and other microbes in water or sewage. This porous matrix is used to grow microorganisms for identification and study. Bacteria retained on the very surface of this capillary structure may be kept well and evenly fed, and their growth carefully controlled, with only a few drops of culture medium. Thus, the new filters cut costs of routine tests and increase accuracy at much greater convenience than with standard agar and broth tube techniques. Results of analyses are said to be available in some instances in a very much shorter period of time; for example in the sanitary control of water, in sixteen hours as against forty-eight to ninety-six hours.



Dissolved Oxygen Analyzer

303

Arnold O. Beckman, Inc., South Pasadena, California, has announced the development of a new Dissolved Oxygen Analyzer. This new instrument provides accurate and continuous measurement of dissolved oxygen in such applications as waste disposal, sewage and water treatment plants, manufacture of petroleum products, solvents, chemicals and a wide range of other operations.

The new analyzer combines in one unit a simple physical scrubbing mechanism for removing dissolved gases from the liquid being analyzed and a standard Arnold O. Beckman Oxygen Analyzer for measuring the oxygen in the removed gases. This combination provides a highly accurate measuring system for dissolved oxygen.

The instrument is designed to read percent saturation directly, but scales are also available calibrated in parts per million if desired. Another advantage is that it may be used with any standard potentiometer recorder or indicator, thus simplifying its installation where certain types of recorders are preferred.

Micro-Strainers Offered by Atwood & Morrill in N.E.

304

Noting the article "Operating a Sewage Micro-Strainer," by C. E. Keefer, of Baltimore, in our August 1954 issue, Glenfield & Kennedy, Ltd., of England, have requested us to call attention to the fact that Micro-Straining equipment is no longer handled by Infilco, Inc. and that information concerning Micro-Straining in the United States can be had by applying directly to Glenfield & Kennedy, Inc. at their New York address, which is care of "The British Trade Promotion Center," 677 Fifth Ave., New York, N. Y.

We are also advised that Atwood & Morrill Co., Salem, Mass., has the exclusive agency for the New England territory of the U.S.

Gas Engine Drive Electric Eel

305

Ohio Tool and Engineering Co., Springfield, Ohio, has developed a new Electric Eel designed to clean sewers, waste and process lines from 4 to 16 inches in diameter, and built for use where electricity is not available. The new Eel cleans out roots, stones and debris in one speedy operation. It will clean lines up to 500 ft. in length and can be easily operated by one man.

The unit is powered by a 2 H.P. gasoline engine which has a built-in

clutch and a transmission which provides two forward speeds, as well as a reverse. Final drive is through two "V" belts to a countershaft which is equipped with an overload clutch. For extra maneuverability, the entire unit is mounted on rubber tired chassis which has two 8" casters on the front.

The dual cable used on the machine is self-feeding and completely eliminates helixing and loss of cable in the line. This cable is available in 8 foot sections so that it is inexpensive to replace in the event of damage.

This new Electric Eel is furnished with a complete set of cleaning tools. For manhole work, such appliances as guide tubes, guide tube jacks, swivels, etc., are also available.

Flexible Steel Coupling For Large Diameter Pipe

306

R. H. Baker & Company, Huntington Park, California, has developed a new flexible steel coupling for large diameter pipe lines (24" to 96").

These couplings have application in water, gas, oil and sewage lines because they are easy to install; they provide a bottle tight seal and yet, are flexible enough to allow for expansion, contraction and misalignment. Special expansion jointing is not required on a pipe line when these couplings are used on all joints. Welding is completely eliminated and only a wrench is required to couple a string of pipe. Baker AllSteel couplings consist of a formed middle ring, two rubber gaskets, two follower-flange rings and heavy bolts. Two types of gasket are available Lastite Rubber and Lastite Neoprene. Middle rings are made in various thicknesses and lengths.

Sealing Compounds at Work!

PRESSTITE'S *cold applied 3-step sewer joint sealing system*

Prevents Overloading Sewage Disposal Plant

Extensive ground water infiltration can overload planned capacity of the disposal plant, resulting in serious trouble and expense. To prevent this, engineers specified Presstite's 3-step system to seal the recent 17-mile Decatur, Ill., sewer project.

Developed through extensive research, Presstite's economical proven system insures tighter, more dependable joints with three simple steps:

1. Presstite PRIMER . . . painted on bell and spigot ends before laying pipe, provides a better bond.

2. Plus Presstite ROPAX® . . . non-porous packing provides *additional* joint sealing material, forms solid seal impervious to passage of water.

3. Plus Presstite KALKTITE® . . . cold mixed, cold applied asphaltic cement completes sealing. Sets up under the most adverse conditions, forms dense, tough, flexible seal that *keeps water out!*

It's as simple as 1-2-3! You get tighter joints plus saving time and money with Presstite's 3-step system.

PRESSTITE SEALING COMPOUNDS

WRITE TODAY
for 20 page detailed catalog, samples and prices.

PRESSTITE ENGINEERING COMPANY
3780 Chouteau Avenue St. Louis 10, Mo.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Insulating Outlet Corporation Stop

307

Mueller Co., Decatur, Illinois, has developed a new corporation stop, designed to minimize corrosion due to electrolytic action.

This new corporation stop features an insulating coupling outlet for copper service pipe which completely insulates the copper service line from the outlet of the corporation stop. This insulation breaks the electrical circuit caused by highly conductive soils or vagrant currents, thereby reducing the danger of corrosion to a minimum.

Copper service pipe is flared in the normal manner with standard flaring tools, assuring maximum rigidity with less possibility of pull-out after installation.

This new corporation stop is furnished in ¾" size with either Mueller Thread Inlet or Iron Pipe Thread Inlet.

For Quick Repairs Use Mechanical Joint

M & H REPAIR SLEEVES

This sleeve makes a quick, permanent repair to a cracked or damaged main. It is easy to install – a good item to keep in stock for emergency use.

Supplied with the sleeve are split end-gaskets, split glands or follower rings, and longitudinal gaskets. Installation consists simply of placing the two halves of the sleeve and accessories around a broken pipe and bolting tight the joints. The longitudinal gaskets of the sleeve fit against the end gaskets, making a water-tight rubber seal. End gaskets are supplied to fit Classes AB or CD pit cast pipe, or Classes 100, 150, 200 and 250 centrifugally cast pipe. Available in sizes 4-inch to 16-inch.

For complete information, write or wire M&H VALVE AND FITTINGS COMPANY, Anniston, Alabama.

M&H PRODUCTS FOR WATER WORKS • FILTER PLANTS INDUSTRY • SEWAGE DISPOSAL AND FIRE PROTECTION

Computing Service Offered

308

Mathematical Computing Service, Bayside, N. Y., specializes in performing services for industries desiring engineering calculations, charts and nomographs of a high degree of complexity and the treatment of related mathematical problems in the fields of chemical and civil engineering.

An important function of the group is the mathematical formulation and complete solution of a problem from given physical data. The staff of the company consists of consultants holding Doctorate Degrees who are qualified to treat problems in applied mathematics related to the physical sciences.

Water Conditioning Systems Without Chemicals

309

Sherwood Water Treatment Co., Beverly, N. J., has announced fully automatic water-conditioning systems that remove from water such corrosive agents as iron, mineral salts, odor, taste, H_2S, CO_2, etc., without the use of either zeolites or chemicals, and at the same time produce a non-corrosive, clear, pure water for municipal, industrial, and domestic uses.

According to the company, the important part of the Sherwood system is the synchronized "Oxidator," a special patented device for proportionately disbursing the proper amounts of oxygen molecules to contact and satisfy all iron, mineral salts and other impurity molecules in the water. The mineral salts are transformed into minute particles in a period of less than one minute, and are then removed by filtration. In addition, the system provides for further treatment to adjust the carbon dioxide and other gas content to a near neutral point and for adjusting the pH.

The system has been designed and engineered to reduce floor space and to keep initial cost low. Treatment rate is up to six gallons per square foot per minute, and plant maintenance and operating costs are low, due to its unique design.

Robot Units Monitor Texas Water Plant

310

A contract in excess of $65,000 to build an automatic control system to monitor operations of a new $1,000,000 water filtration plant at Fort Hood, Texas, has been awarded the Minneapolis-Honeywell Regulator Company.

(Continued on page 108A)

On Main Street, or in the wild upper peninsula, you need the "Big 3"

There's a big copper refining plant on the shores of Lake Superior, near Ontonagon, Michigan.

They use a lot of water.

They wanted a *trouble-free* water line . . . one that would be as *nearly ageless* as man could devise . . . one with *great strength* to resist earth loadings . . . one with *sustained high capacity.*

These "Big 3" requirements were important to the White Pine Mining Company—so they specified Price Prestressed Pipe for a new 25,000 foot line of 36-inch pipe.

The same "Big 3" requirements were recognized by Miami, Louisville, Cleveland and many other cities large and small. Now they use Price Pipe.

You, too, need a pipe line that meets *all* 3 of the "Big 3"... *long life, great strength* and *sustained capacity.* Don't be satisfied with less.

Before you specify your new water supply line, call in our engineers. They'll show you how to get a trouble-free line of ageless concrete at the lowest possible cost.

Price Brothers Company

1838 East Monument Ave., Dayton 1, Ohio

Member American Concrete Pressure Pipe Association

Concrete Pressure Pipe for Water Supply, Subaqueous, Pressure Sewer and Culvert Installations

The new plant, located some eight miles from Belton, will provide water for the Army installation at Fort Hood as well as the neighboring town of Killeen. It will be capable of supplying more than 7½ million gallons daily. It is scheduled for completion in June, 1955. It will use water from the Leon river impounded in Belton reservoir, a project recently completed by the Army Corps of Engineers.

The control system, developed by Honeywell's Industrial Division engineers, will primarily be pneumatic. It will regulate such conditions as flow measurement, degree of acidity and the various filtering stages. The control system feeds into two centrally located master control panels which provide over-all supervisory monitoring and regulation of the system.

Aluminum Caps For Test Tubes

311

Lowell S. Fisher Company, Indianapolis, Ind., has developed Alumi-Caps for use with test tubes instead of old-fashioned cotton plugs. Alumni-Caps are sterilized aluminum caps which are slipped over the tops of culture tubes. They protect the contents from contamination carried by dust in the air, yet fits loosely enough to permit aerobic conditions in the tubes.

The caps can be dropped over the top of a test tube in a matter of seconds. They are available in a variety of permanent colors which speed recognition of different cultures, and eliminates the need for labels. Alumi-Caps are all 30 mm long regardless of diameter, and can be made to fit any size test tube.

Pipe Line Equipment
WATER • GAS • SEWER

Bottled Gas Lead Melting Furnace

Asbestos Joint Runners

Best quality asbestos rope, brass caps attached to each end. Equipped with clamps.

M-D Cut-In Connections for Sewers

A light cast iron fitting with bell end for connecting house service with main sewer pipe without necessity for placing a Y-branch or T-branch in the sewer line.

Leak Detector

A truly fine instrument designed to solve even the most difficult leak detecting problem.

Calking Tool Outfit

For water mains up to 12". Strong leather bag. Keeps the right tool for every job within easy reach.

Test Plugs for Bell or Spigot End Cast Iron Pipe.

On this page are shown only a few of the hundreds of items to be found in the POLLARD Catalog. Write for a copy of Catalog No. 25G.

Portable Lead Melting Furnace

A handy outfit for quick action, equipped with gasoline burner.

Pipe Cutter

Inexpensive way of cutting pipe. Every wheel in contact with the pipe is a cutting disc, so cutter need be moved only a short distance to cut entirely around the pipe.

Tapax

The original manhole cushion. Takes the bang out of manhole covers.

M-Scope Pipe Finder

It's easy to locate a buried pipe line with this handy pipe finder.

JOSEPH G. POLLARD CO., INC.

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Chicago, Ill.

MAIN OFFICE AND FACTORY
New Hyde Park, N. Y.

Southern Office
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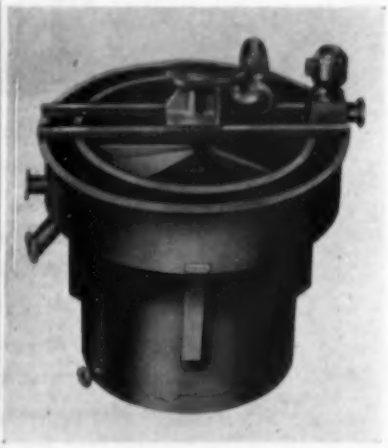
Atlanta, Ga.



New Gravity Flotation Clarifier

312

Pacific Industrial Engineering, Inc., Pasadena, California, has announced the development of a new Gravity Flotation Clarifier for the field of industrial waste treatment.

The new separator does not require the use of pumps or instrumentation and may be installed economically across existing sewer or waste lines. Operation of the unit is fully automatic to treat variable flows and clarification efficiencies of over 90% are achieved.

Installations are made to enable water conservation, to recover lost products and to meet pollution control regulations. The new method and equipment is highly efficient for such applications as oil refinery effluent treatment, meat packing grease recovery, chemical processes, paper mill fiber recovery, aircraft and automotive maintenance wastes, machine tool coolant recovery, soap manufacture, etc.

Pacific Industrial Engineering, Inc. maintain complete survey, testing, equipment design and supply services for management, consultants and contractors.

Easy-Operating Eccentric Plug Valves

313

DeZurik Shower Co., Sartell, Minnesota, has developed an Easy-Operating Plug Valve.

The valve utilizes a plug which has an eccentric face matched to an eccentric seat; this combination provides a wedge action which not only closes tightly, but is self-compensating for minor wear. The plug face is rubber bonded to a rigid metal core, therefore the plug is strong basically yet with a resilient face which seals around obstacles or foreign solids in the flow.

According to the company, once the plug face is free of the seat, and it takes only a fractional turn of the handle, the plug swings completely out of the way with an easy quarter-turn of the handle. Action is friction-free, no lubrication is required on the journals, thus maintenance is reduced and leakage is eliminated. When plug replacement is required, no lapping or fitting process is involved.

DeZurik valves are furnished in all models and metals. In addition to flanged and screwed ends, they are available in mechanical joint and hub ends.

Send for new information on R-C Rotary Positive Blowers

CHECK THE "BIG 4" ESSENTIALS

1. Accurate volume at required pressure
2. High efficiency—low operating cost
3. Low maintenance cost —low down time
4. Freedom from oil or oil vapor contamination

Check your present blowers and if they don't measure up, it may be an economy to replace them with modern R-C equipment.

For your present needs, or for future reference, you'll find highly useful information on the smaller sizes of Roots-Connersville Rotary Positive Blowers in this new Bulletin No. AF-154.

Especially important are the tables showing sizes, pressures, capacities and other characteristics to help you select blowers for specific applications.

You'll also find included factual data which points out why R-C Blowers meet the "BIG 4" essentials of successful performance.

If your files are not complete on other Roots-Connersville equipment for handling air and gas, ask for bulletins on:

Centrifugal Blowers and Exhausters . . 120-B-14
Positive Displacement Meters . . M-152
Gas Pumps (small) 31-B-17
Gas Pumps (large) 32-33-B-13
Spiraxial Compressors. SC-354
Vacuum Pumps 50-B-13
Inert Gas Generators 100-B-14
Rotary Positive Blowers (large sizes) . . RB-254

For any problem of handling gas or air, consult Roots-Connersville, now in their second century of building such equipment, exclusively.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
355 Mount Ave. • Connersville, Indiana

Roots-Connersville Blower (Canada) Ltd. • 629 Adelaide St. W., Toronto, Ont.

Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiraxial Compressors

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Chemical Cleaning of Water Wells

314

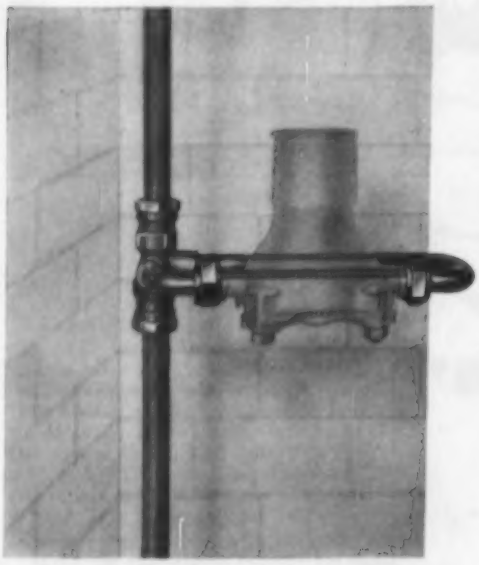
Calgon, Inc., Pittsburgh, Pa., has developed a new chemical preparation called "Weltone," for cleaning and developing water wells.

Weltone was developed in response to a demand for a "package" well cleaning preparation that could do the complete job of well cleaning. Weltone contains Calgon, the well known water conditioning agent, plus a disinfecting agent, a wetting agent for better penetration, and other chemicals designed to improve the well cleaning process. Therefore, the manufacturer reports that it is no longer necessary for the well driller or well owner to purchase and assemble the required chemicals from several different sources.

At the same time, Weltone is said to retain all the well cleaning properties of Calgon, including the ability to remove minerals deposited from the water, as well as clay and silt from well screens and water bearing strata. Unlike acid, Weltone works on the principle of dispersion rather than complete dissolution. Vigorous agitation is required, and the loosened deposits must be flushed to waste before putting the well back into service.

Weltone is also described as containing an effective sterilizing or disinfecting agent. Its purpose is to destroy growths of bacteria or other organisms that may be growing in the well or strata and contributing to the drop in capacity. Iron fixing bacteria are particularly troublesome in this respect.

Weltone is safe, Calgon, Inc., says; it will not harm metals or concrete; it can be used in concrete cased wells with the pump in place; it will generate no dangerous fumes, as acid sometimes does.



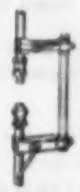
For Setting Meters in Basements

EASY TO INSTALL

The KORNERHORN

In a vertical basement pipe, against the wall or in a corner, the Kornerhorn makes a most satisfactory meter setting. Installation is fast and economical as pipe threading is eliminated. Send for detailed information.

1. Cut supply line. Clamp not necessary but convenient



2. Add Connections

3. Kornerhorn in place

When Valves are Needed

Ford Kornerhorn valves installed on the supply side, or on both sides of the Kornerhorn add extra convenience and cleanliness when meters are changed.

THE FORD METER BOX COMPANY, INC.

FOR BETTER WATER SERVICES

Wabash, Indiana

FORD

Control Station Simplifies Pneumatic Control Supervision

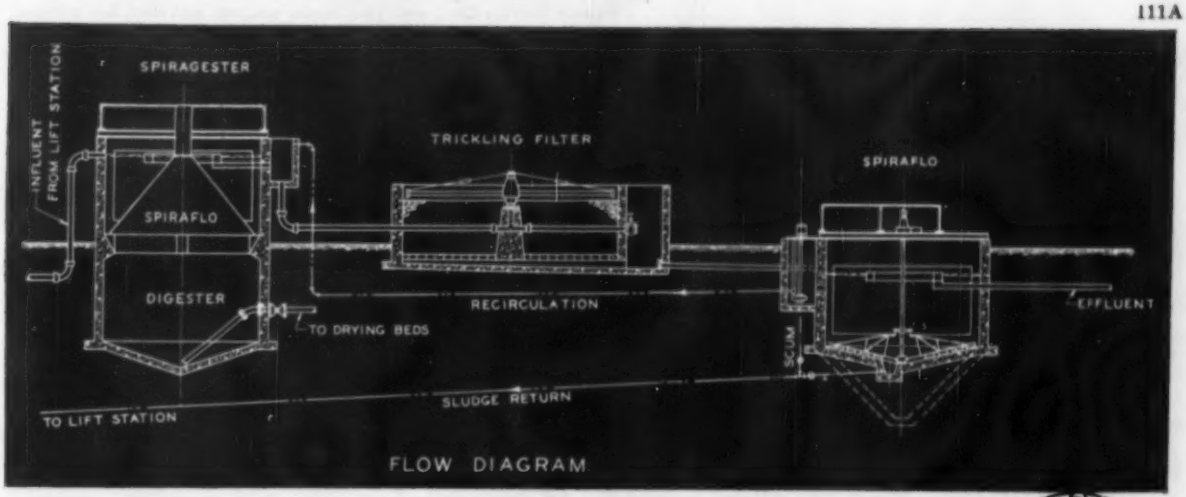
315

Bailey Meter Co., Cleveland, Ohio, has developed a new control station in which all vital operating indications and control for pneumatic control systems are concentrated in a single control station. The Bailey MINI-LINE Control Station provides a complete picture of control system performance and full flexibility of remote control.

An operator has the choice of remote manual control independent of all automatic controllers for starting and stopping the process and for periods where the measuring and/or controlling elements may be out of service. Quick transfer from automatic to hand may be made without any disturbance to the process.

Vertical gauges indicate signals from the transmitter, set point or bias, hand control, and automatic control. The three control knobs are for automatic-hand selection, set point or bias adjustment, and hand control.

This unit operates on standard SAMA signal ranges of 3-15 or 3-27 psig. Control desk flush mounting uses an area only 6¼" x 4½". Gage accuracy is within ±½% of signal range, and air consumption is less than 0.2 cfm.



FLOW DIAGRAM

YEOMANS
Spiragester

Combination clarifier and sludge digester—for primary and secondary treatment —is securing results like these:

45% Removal of B.O.D.—65% Removal of Suspended Solids—

100% Removal of Settleable Solids.

Solids removal is accomplished in the upper portion of the Spiragester by spiral downward flow of the influents introduced tangentially into an annular race, and enters clarification compartment at bottom. Diffusion is slow, uniform.

Settled solids in the clarification section enter the digestion compartment, mix actively with digesting material and are attacked by organisms which stabilize the sludge.

In the layout illustrated, secondary treatment is provided by a high capacity trickling filter and final sedimentation by a Spiraflo clarifier.

Ask for Typical Case History Performance Data. See your local Yeomans representative listed in the Yellow Pages of your telephone book under "Pumps," or write factory direct.

Yeomans Brothers Company, 1999-9 N. Ruby Street, Melrose Park, Illinois

Manufacturers of: Distributors • Clarifiers • Digesters • Mechanical Aerators • Pneumatic Sewage Ejectors • Centrifugal Pumps

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

Rust Remover Powder

316

The By-Buk Company, Los Angeles, Calif., has announced a new and unusually effective non-toxic rust remover, in powder form.

When mixing the powder with water, the strength of the resulting liquid rust remover can be controlled to meet any derusting or corrosion removing requirement for ferrous or non-ferrous metals, according to the company. It is said to leave the derusted surfaces metallically clean with a thin rust-resistant coat, ready to form a perfect bond for paints, plating, galvanizing and other protective coatings.

For vertical surfaces and large objects, which cannot be submerged in a liquid bath, a thickening agent is added to the liquid solution to make a syrupy substance which will adhere to such surfaces.

New Hydraulic and Mechanical Design for Turbine Pumps

317

A. O. Smith Corporation, Los Angeles, Calif., has announced that a completely new hydraulic and mechanical design is featured in recent additions to the Company's vertical turbine pump line. According to the Hydraulic Products Group of the company, this new design incorporates a radically new impeller type, producing higher head and efficiency with extremely low NPSH, new renewable wear rings of virgin aluminum-bronze, new SMITHway high pressure dual seals and new low-loss suction bells.

These SMITHway pumps are now available in 10", 12" and 14" sizes, covering the range from 400 through 2100 GPM. According to the company they are forerunners in a planned program of expansion to serve industry with pumps throughout the entire commercial range, which will exceed all present standards of performance and useful life.

Hardinge CLARIFIERS for circular tanks

Two Hardinge 100'-diameter, center-column final clarifiers at the municipal sewage disposal plant in York, Pennsylvania. (Albright and Friel, consultants)

Hardinge Clarifiers and Thickeners are being used in:

- SEWAGE TREATMENT PLANTS for primary and final clarification and sludge thickening.
- INDUSTRIAL WASTE TREATMENT of all types.
- WATER TREATMENT, industrial and public.

A wide selection of sizes and arrangements is offered:

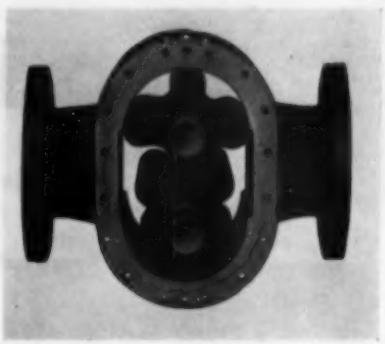
- Normal duty and "Auto-Raise" heavy duty mechanisms.
- Beam, truss and center-pier supported units.
- Side feed and under feed.
- Spiral and segmented rakes.
- Mechanical, hydraulic or electrical overload protection.

Detailed specifications for all types and sizes are available upon request. Bulletin 35-D- 15

HARDINGE
COMPANY, INCORPORATED

YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

New York • Toronto • Chicago • Hibbing • Houston • Salt Lake City • San Francisco



Positive Displacement Rotary Pump

318

Lindquist Pump Corporation, Culver City, Calif., has incorporated a radical new design in the Lindquist Positive Displacement Rotary Pump that is said to provide greater efficiency and economy at approximately ½ the cost of comparable pumps.

These pumps are made in a range of sizes to handle all types of liquid solutions with capacities up to 2200 G.P.M. and pressures up to 1000 P.S.I. They will pump anything from water to high viscosity fluids and solids up to 78%, and are fully reversible. Pump action will not break up semi-solids or aerate liquids.

The pump works under the positive displacement principle wherein the unmeshing of the rubber impellers produces a vacuum drawing the liquid into the space between the lobes. The liquid is carried between the lobes and case housing to the opposite side of the pump then forces the liquid into the discharge line.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

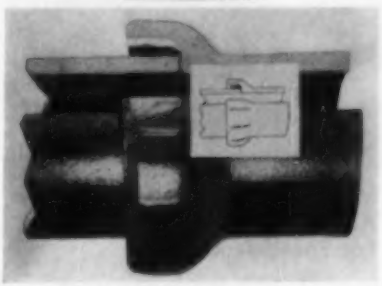
Flowtrol Valve

319

Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has developed a Cushioned Flowtrol Valve.

The Golden-Anderson Flowtrol valve was designed to replace troublesome globe, angle, plug or gate valves that require frequent manual opening and closing at considerable waste of time and effort.

One man can easily operate the G-A Flowtrol valve to either the fully open or tightly closed position—when the valve size is 2" or 36"—or when the pressure in the line is 15 psi or 400 psi.



Mechanical Clay Pipe Joint

320

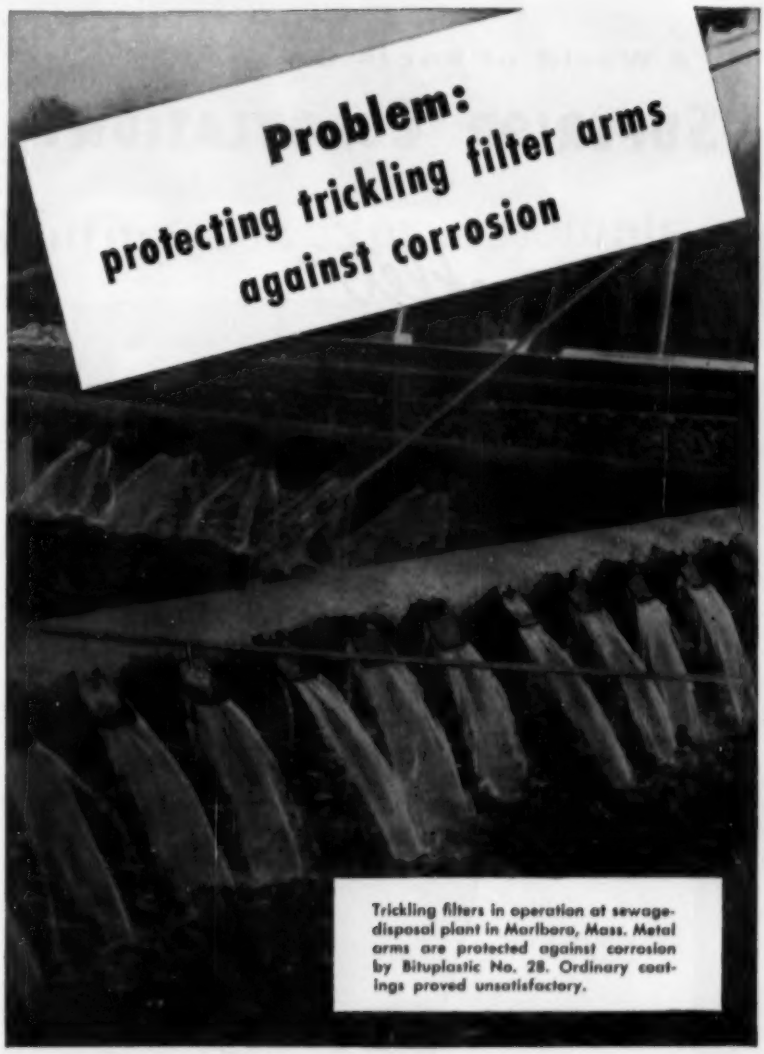
American Vitrified Products Company, Cleveland, Ohio, has developed a new low cost, mechanical joint for vitrified clay pipe.

The Amvit Joint, the name under which this new development will be marketed, is a push type joint based on the ball and socket principle. It consists of a plastic ring die cast electrically in the bell of the pipe having a concave exposed surface and a plastic ring die cast electrically on the spigot having an exposed convex surface. The diameter of the spigot ring is somewhat larger than the largest diameter of the bell ring. When the two are pushed together, the rings are in constant compression. The joint is thus root-proof and infiltration-proof.

The cast rings, which are molded to the pipe by a new patented process at the factory, are made of plasticized resins of polyvinyl chloride. This material is impervious to most all acids and alkalies, oils, and other sewage and industrial wastes. It is readily adaptable to casting and stands weather without harm, either physically or chemically.

Having a rubber-like joint and a ball and socket design gives optimum flexibility to the line. The line can be a total of 14 degrees off center, or 7 degrees in either direction. Using 6 degrees of flexibility, it would require 7½ pipe 2 feet long to make a

(Continued on page 114A)



Trickling filters in operation at sewage-disposal plant in Marlboro, Mass. Metal arms are protected against corrosion by Bituplastic No. 28. Ordinary coatings proved unsatisfactory.

• The Marlboro Sewage Department had an annoying problem. When conventional coatings were used, metal arms on trickling filters corroded quickly—so quickly that maintenance was a seemingly endless chore.

Then, a new method was tried. Metal surfaces were sand blasted, and given one coat of Bitumastic® Priming Solution, followed by two coats of Bituplastic® No. 28. Three years later the coating was inspected. In spots, there was slight evidence of chipping and cracking; but, in general, the coating was in excellent condition.

The Marlboro Sewage Department is well satisfied with the performance of Bituplastic No. 28 . . . no other coating has ever come close to this record.

Koppers makes a family of cold and hot-applied protective coatings, each specially formulated to control specific kinds of corrosion. Write for complete information on how these durable coatings can give your sewage plant long-lived protection against corrosion.

Protection for Water Lines

Koppers makes hot-applied Bitumastic® Enamels that protect interior and exterior surfaces of large-diameter water lines against every corrosive force found underground. Write for free literature.

MADE ONLY BY KOPPERS

BITUMASTIC® PROTECTIVE COATINGS

SOLD THROUGH INDUSTRIAL DISTRIBUTORS

KOPPERS®

KOPPERS COMPANY, INC.

Tar Products Division, Dept. 361-T, Pittsburgh 19, Pennsylvania

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, PITTSBURGH, AND WOODWARD, ALA.

• If interested in equipment or literature mentioned below, mail a Reader Service Card with your name, address, and item key number.

A World of Facts On

SUPERIOR COAGULATION!

Free Booklet—

We want you to have a copy of this completely revised, up to the minute booklet that contains a world of information that will greatly assist you in problems you may have in **WATER TREATMENT, SEWAGE TREATMENT, INDUSTRIAL WASTE TREATMENT, SLUDGE CONDITIONING,** and other uses of Ferric-Floc.

Drop us a card for your copy of this booklet that contains valuable information for you.

TENNESSEE CORPORATION

617-629 Grant Building, Atlanta, Ga.

(Continued from page 113A)

90 degree turn with a radius of approximately 9½, or 30 pipe to make a circle 19 feet in diameter.

The compression within the joint is constant and so designed as to withstand hydrostatic pressure tests of more than 30 psi, far exceeding any required.

Automatic Control For Speed-Trol

321

Sterling Electric Motors, Inc., Los Angeles, Calif., has announced that the Conoflow pneumatic control is now available on their Speed-Trol, variable speed transmission.

The Conoflow pneumatic control utilizes a Cono motor and provides an automatically controlled drive for processing operations involving variables such as pressure, liquid level, flow, etc. The control is available in both manual and automatic types which are sensitive to many types of electric, mechanical or pressure signals.

New Maintenance Coating

322

Atlas Mineral Products Co., Mertztown, Pa., has announced the commercial availability of Atlas Hypalon maintenance coating based on du-Pont's Hypalon chlorosulfonated polyethylene.

Atlas Hypalon maintenance coating is flexible, self-curing, readily applied in heavy coats, and has excellent adhesion to a wide variety of surfaces.

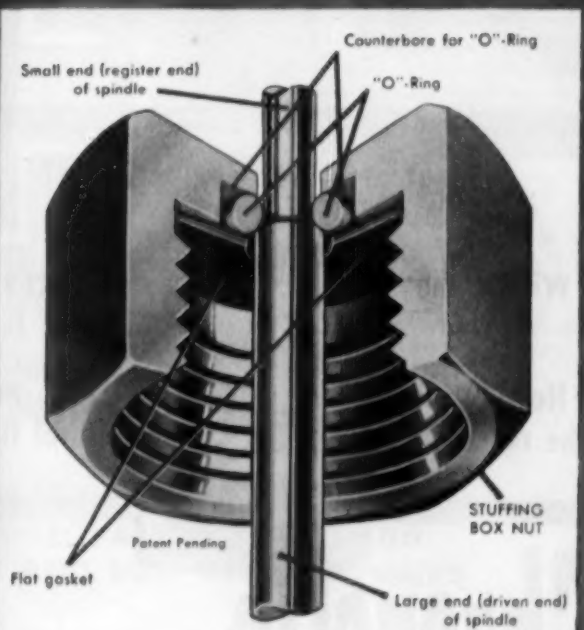
Hypalon has outstanding resistance to weathering, high temperature and highly corrosive fumes and liquids including nitric acid, chlorine dioxide, hydrogen peroxide and chromic acid as well as inorganic acids, alkalies and salts.

Atlas also has available Atlas Hypalon tank linings for applications where conventional sheet linings are not satisfactory.

Now it has been proved...

The Exclusive Rockwell "O"-RING Water Meter Stuffing Box Nut Assembly

Eliminates Stuffing Box Leaks, Binds, Troubles, Expense...



Cutaway View in Enlarged Detail

HOW IT WORKS

This sectioned view shows how the "O"-Ring press-fits into a counterbore in the packing nut. The counterbore has a slightly smaller diameter than that of the "O"-Ring to hold the ring under compression. This slight compression alone seals the stuffing box spindle bottle-tight *without binding*. The nut can be force tightened with a wrench without applying any additional compression.

Three Years of Proven Success In The Field

The Rockwell "O"-Ring Stuffing Box Nut Assembly was perfected over three years ago. After extensive laboratory and field tests and without any "fanfare" or publicity it has been used in Rockwell water meters built since that time. The superior performance of "O"-Ring construction is now a proven fact. It provides a permanent, leak tight seal at a very vulnerable point. And it actually improves meter performance by reducing friction at the stuffing box spindle. You get it only in Rockwell meters of all sizes and types. There's no extra cost, but a lot of extra value and satisfaction. Ask your Rockwell representative to demonstrate this great new advance in water meter construction.

The Rockwell "O"-Ring assembly is also available as an economical replacement part. It is interchangeable with the stuffing box nuts on all earlier model Rockwell meters.

ROCKWELL MANUFACTURING COMPANY PITTSBURGH 8, PA.

Atlanta Boston Charlotte Chicago Dallas Houston Los Angeles Midland, Texas N. Kansas City, Mo. New York Philadelphia Pittsburgh San Francisco Seattle Shreveport Tulsa

W&SW

Manufacturers' News

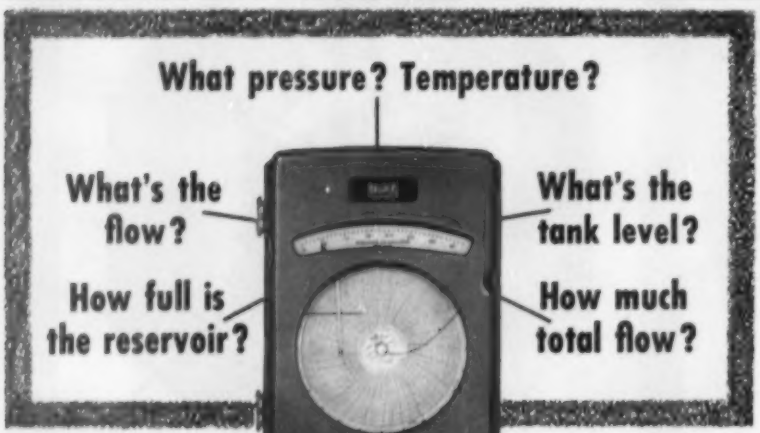
New Pipe Coating Plant For Denver

Hill, Hubbell & Co., Cleveland, Ohio, has announced the opening of its new pipe coating plant in Denver, Colorado. Located on a 20-acre site, the new Hill, Hubbell mill is the largest operation of its kind between Chicago and the Pacific Coast and has been established to serve pipe line construction in the entire western United States.

Pipe from Colorado steel pipe mills, as well as from the East and far West, will be processed in the new Denver plant—and delivered to construction projects throughout the Western states.

As the first company in the United States to factory-wrap and coat pipe, Hill, Hubbell has taken the lead in bringing facilities to serve the fast-growing West.

According to M. M. Bowen, Vice-president and General Manager of Hill, Hubbell and Company, the new Denver plant is a logical development in an area where pipe installations are steadily increasing in number. The present and potential growth in oil, natural gas and petroleum products lines—and the increase in water supply and public utilities lines necessitated by growing populations—give importance to the new Hill, Hubbell factory.



Chronoflo

brings you the answers

By transmitting and receiving information over a simple two-wire circuit, Builders Chronoflo TELEMETERS produce important economies for water and sewage plants and industrial process systems.

(1) Chronoflo saves time — gives immediate indications of changes in flow, total flow, pressure, temperature, level.

(2) Chronoflo saves steps — brings information from any point, no matter how far distant to a central control panel for more efficient supervision and system control.

(3) Chronoflo reduces personnel responsibilities — eliminates necessity for on-location supervision of distant pumping stations, storage facilities, reservoirs, standpipes, valve positions, etc. . . . Chronoflo also controls pumps automatically.

(4) Chronoflo is tested and approved — by thousands of installations in all types of water and sewage applications.

Chronoflo is one of the many Builders metering and controlling systems for modern plant operation. Write for your copy of Bulletin 230-H4 describing Builders Chronoflo Telemeters, or tell us about your own metering and controlling problem. Builders-Providence, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

BUILDERS-PROVIDENCE

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • OMEGA MACHINE CO.

METERS FEEDERS CONTROLS

Fischer & Porter Forms German Affiliate

A German affiliate, Sartorius-Fischer, Göttingen, Germany, has been recently organized by Fischer & Porter Company of Hatboro, Pennsylvania, for manufacture and sales of industrial process control instrumentation and chlorinators. Formed with Sartorius-Werke, producers of the world-famous analytical balances, the new affiliate will manufacture under Fischer & Porter patents and designs.

With plants already producing in England, France, and Holland, the new German facility will permit efficient service to the entire European industrial instrumentation market.

Continental Can Buys Tenco, Inc.

Tenco, Inc., Winona, Minnesota, manufacturers of plastic pipe fittings, has been purchased by Continental Can Company, according to John G. Murray, Vice President of Continental's Bond Crown and Cork Division, and R. J. Harkenrider, President of Tenco. The Tenco line of plastic pipe fittings will become a part of Continental's Plastic Division.

Mr. Harkenrider will be available in an advisory capacity for continued development of the plastic pipe fitting line.

H. W. Ford Retires From Pittsburgh-Des Moines

Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., has announced that H. W. Ford, sales manager of the company's Eastern District and a director of the firm since 1931, has retired from both positions. He is being succeeded in his sales post by his brother, C. R. Ford, who has been his associate for many years.

"Hap" Ford joined PDM more than 42 years ago, shortly after his graduation as a civil engineer from the University of Michigan. His sales activities started in 1914 when he was transferred to the company's New York office.

In 1929 Mr. Ford was named New York District sales manager, a responsibility he retained until his retirement—a total of nearly twenty-six years on the job. In recent years, with the transfer of the office to Newark, his title has been Eastern District sales manager.

In recognition of Mr. Ford's retirement, John E. Jackson, president of PDM, gave a dinner in his honor in Pittsburgh. Officers of the company presented him with a sterling silver ice bucket with an appropriate inscription. The presentation was made by Mr. Jackson, who also delivered a tribute to Mr. Ford, both as a director and as manager of one of the company's largest branch sales offices.

B-I-F Promotes R. W. Pearce

B-I-F Industries, Inc., Providence, R. I., has announced that Mr. R. W. Pearce, Manager of Chlorinizer Sales, has been promoted to the post of Works Manager. This position has been vacant since February, 1953, when Mr. Earl H. Bradley, Works Manager at that time, was elected President of B-I-F Industries.

Born in Woonsocket, R. I., Mr. Pearce attended Providence Technical High School and was graduated from Brown University in 1936. That same year, he started with Builders Iron Foundry as a machinist; from that time to the present, Mr. Pearce has served the company in such posi-

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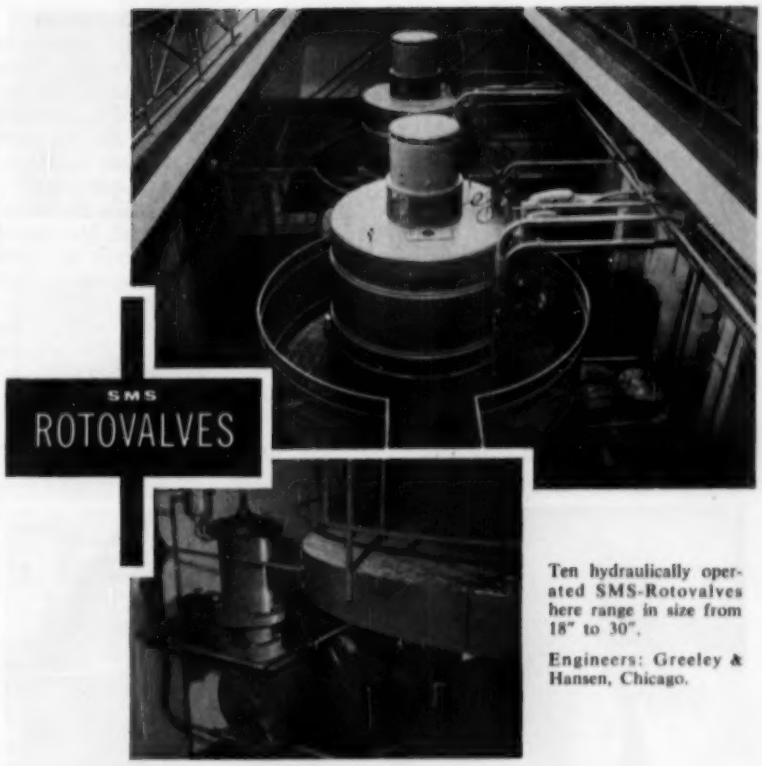


Ten hydraulically operated SMS-Rotovalves here range in size from 18" to 30".

Engineers: Greeley & Hansen, Chicago.

For the City of Niagara Falls, N. Y. . . .

SMS-ROTOVALVES SAFEGUARD HIGH AND LOW SERVICE PUMPS

SMS-Rotovalves were specified to safeguard service pumps in the City of Niagara Falls' new pumping station. Greater initial shut-off and positive control of closing time made them a logical choice to minimize water hammer in pump start-ups and shut-downs. Because SMS-Rotovalves have less pressure loss with a full line opening than other valve types, they save pumping power.

In addition to the SMS-Rotovalves, SMS Babbit-Seated Butterfly Valves meet the rugged, high service header requirements of fast, positive closure. At the adjacent filtration plant, 76 R-S Rubber-Seated Butterfly Valves were specified to give drop-tite closure, unusual economy of layout space and cut initial construction costs.

Whatever your application requirements, SMS has the experience and facilities to meet them. For additional information on our complete line of cone, ball and butterfly valve, see our local representative or write the S. Morgan Smith Company, York, Pennsylvania.

Hydraulic Turbines · Pumps · Gates & Hoists · Trash Rakes · Accessories

HYDRODYNAMICS

Rotovalves · Ball Valves · Butterfly Valves · Free-Discharge Valves · Controllable-Pitch Ship Propellers

SMS S. MORGAN SMITH CO.

Affiliate Company: S. Morgan Smith, Canada, Limited, Toronto

(Continued from Page 117A)

tions as toolmaker, estimator, production controller, router, manager of machine tool sales, manager of the war contracts division, project sales engineer, and most recently, Manager of Chlorinizer Sales, where he became widely known in the field of chlorination.

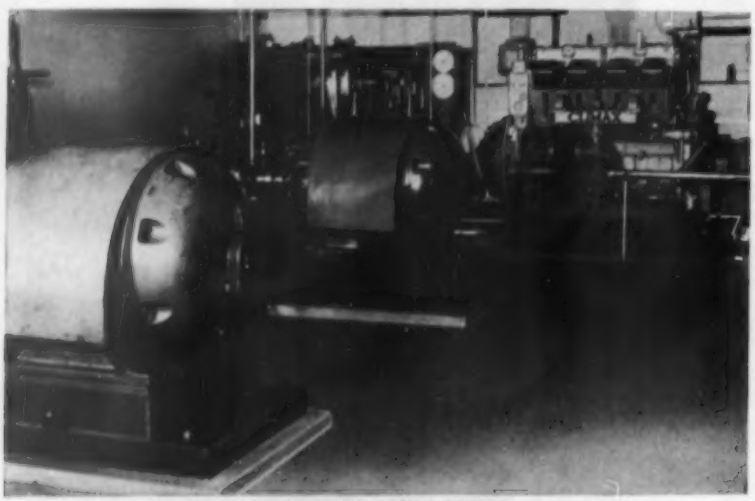
His memberships include the American Water Works Association, the American Ordnance Association, New England Sewage and Industrial Wastes Association, Rotary International, and the Providence Engineering Society. Mr. Pearce is a director of Builders-Providence, Inc.

New Permutit Sales Engineers

The Industrial Sales Department of The Permutit Company, New York, N. Y., has announced the appointments of Messrs. K. G. Barnhill and E. J. Connelley to the positions of Sales Engineer at Boston, Mass., and Cincinnati, Ohio, respectively.

Mr. Barnhill will assume the duties of E. L. Root, deceased. He joined the Permutit organization in 1939 and served at the Cincinnati office until his new assignment.

Mr. Connelley will assume the duties of Mr. Barnhill. He became associated with Permutit in 1948 and actively served in the Chicago, Ill., office under the direction of W. H. Mitchell.



CLIMAX ENGINES

PROTECT COLORADO SPRINGS WATER SUPPLY

Bringing water over a mountain makes Colorado Springs' problem differ from some, but as in many other cities, uninterrupted service is insured by the installation of Climax standby engines.

Lifting water approximately 1600 ft. through 16 miles of pipe, in 800 ft. stages, the two pumping stations each include two 2 MGD electric motor-driven pumps and a 1 MGD Climax engine-driven pump.

Pictured is one of the Climax model V-85 propane burning engines direct connected to a 700 GPM centrifugal pump requiring 192 H.P. at 1200 RPM.

Project designed by and constructed under the supervision of Black & Veatch, Consulting Engineers, Kansas City, Missouri.

climax

FOR COMPLETE INFORMATION, WRITE TO . . .

ENGINE AND PUMP MFG. CO.

208 So. La Salle St.

CHICAGO 4, ILLINOIS

Factory—Clinton, Ia. *District Office*—Dallas, Tex.

L. E. Harper

J. R. Hartley

Harper and Hartley Honored by B-I-F Service Awards

Lyndus E. Harper, President of Omega Machine Co., and John R. Hartley, Vice-President and Manager of Project Sales of Builders-Providence, Inc., received recognition and honor for 25 years of consecutive service at the Annual BIF Industries Awards Dinner on February 19, 1955.

Mr. Harper, who is widely known as "Lindy" to his many friends in the Chemical Feed Industry, has held all positions with Omega Machine Co. from the shop on up to President. He is a member of the AWWA, FSIWA, and the Chicago Engineers Club.

Mr. Hartley, who made the transition from the classroom to Builders-Providence as apprentice draftsman in 1929, is well known in the water and sewage field. His memberships include AWWA, FSIWA, associate member of the American Society of Civil Engineers, Boston Society of Civil Engineers, and the Providence Engineering Society, of which he is first vice-president.

A testimony of their inventiveness is the fact that both men are credited with several patents, currently used by B-I-F Industries.

Everett Elected President of Beaver Tools

Beaver Pipe Tools, Inc., Warren, Ohio, has announced that Mr. Charles T. Everett has been elected President and General Manager, as well as a Director of the Beaver firm.

Everett resigned his position as Vice President at Bingham-Herbrand Corporation and joined Beaver Pipe Tools, Inc., on May 15, 1954, as Executive Vice President and General Manager.

The new Beaver president received his Mechanical Engineering degree at the University of Cincinnati. He was a major in the Army during World War II.

Hagan Corp. Appoints Motheral Advertising Mgr.

Hagan Corporation, Pittsburgh, Pa., has announced the appointment of George B. Motheral as advertising manager. According to W. W. Hopwood, president of the control and instrument company, Mr. Motheral will manage the consumer and industrial advertising, sales promotion, and public relations programs for Hagan and its subsidiaries, Calgon, Inc., Hall Laboratories, Inc., and The Buromin Company.

Mr. Motheral was formerly associated with Pittsburgh Plate Glass Company, Pittsburgh, in sales and advertising since 1940. During the last three years, he served as manager of glass advertising and promotion.

A graduate of Mercersburg Academy and Lehigh University, Mr. Motheral is a director and immediate past president of the Pittsburgh Chapter of National Industrial Advertisers Association and a member of the Association of National Advertisers.

Foxboro Factory Opened in California

The Foxboro Company, Foxboro, Mass., has announced the opening of a new instrument service and assembly building in San Leandro, California. Keeping pace with industry's increased demand for instruments, the new factory has more than doubled the company's West Coast manufacturing facilities, providing 8400 square feet of space for the service, production and sales departments. For the convenience of customers, the building is centrally located on a three acre site at 399 Preda Street, close to the Oakland Municipal Airport and the Eastshore Freeway.

The new factory is fully equipped for all types of instrument work ranging from parts replacements, complete repairs and adjustments to new instrument assembly. Facilities include a shipping and receiving room, a warehouse where parts and completed instruments are stocked to facilitate rapid delivery, booths for welding and lacquer spraying, and

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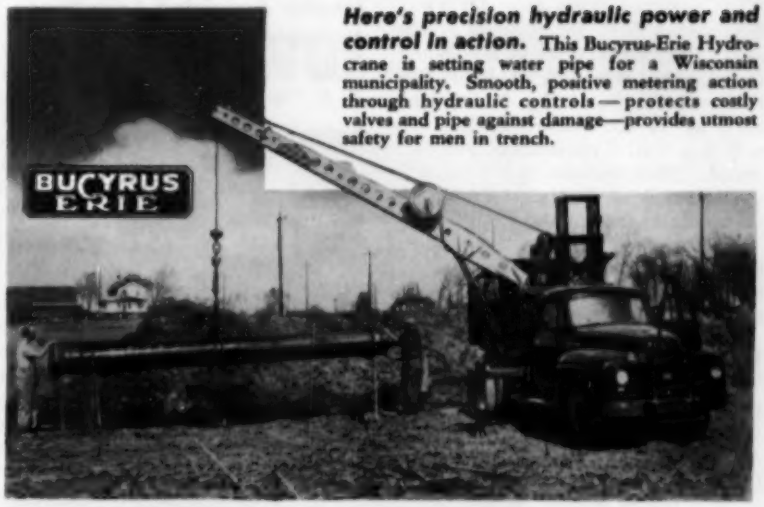


Here's precision hydraulic power and control in action. **This Bucyrus-Erie Hydrocrane is setting water pipe for a Wisconsin municipality. Smooth, positive metering action through hydraulic controls — protects costly valves and pipe against damage—provides utmost safety for men in trench.**

COSTLY JOLTS GONE—

Fluid Action Hydrocrane Gives Cushion Handling to Growing Range of Jobs

About seven years ago the revolutionary Bucyrus-Erie all-hydraulic Hydrocrane first demonstrated its almost unbelievable precision control. On one test it lifted, swung and set down a pyramid of six brimful drinking goblets, carried on a 1-ton steel test slab — without spilling a drop of water. Today greatly improved Hydrocranes and Hydrohoes with greater capacity and far faster line speeds are bringing this outstanding hydraulic precision to an ever increasing number of jobs.

Every crane or hoe function is fully hydraulic — swing, boom hoist, line hoist, boom telescope, outrigger control, clamshell bucket open and close.

You must see a Hydrocrane in action — setting pipe, hydrants, valves; digging manholes; erecting anything from park bleachers to plate glass — to fully realize the advantages of fluid power and control. Arrange a demonstration now! Write for interesting new literature. 60H33

BUCYRUS-ERIE COMPANY • South Milwaukee, Wis.

Wrist-action Hydrohoe speeds trenching. **The new Bucyrus-Erie Hydrohoe features a wrist-action dipper which is hinged at lower end of boom handle and rotates a distance of 65 degrees. Result is bigger loads, better trenches, more biting force, less spillage. Hoe gives you the same precision control, boom telescope, and smooth action of the Hydrocrane. Quickly convertible to crane boom in the field.**

(Continued from page 119A)

separate sections for thermal system filling, calibration and meter testing. In addition, there are assembly sections where Foxboro Instruments such as M/50 Consotrol Receivers and d/p Cell Transmitters are produced. Other sections are devoted to the assembly of control valves and to electronic instrument work.

The modern building, constructed of pre-cast concrete, is so designed that future expansion can be easily accommodated.

Bailey Meter Promotes Shanks

Bailey Meter Company, Cleveland, Ohio, has announced that C. D. Shanks has been appointed a Resident Engineer with headquarters in Charleston, W. Va. Shanks' address is 6C Chilton Manor, Bridge Road, Charleston, W. Va.

A sub-division of the Cincinnati district office, the Charleston territory includes southern West Virginia and western Virginia.

Shanks, who was graduated from the University of Virginia with a Bachelor of Science degree in mechanical engineering (heat power), joined the company in 1949, as a member of the cadet engineering class. His headquarters were in Cincinnati prior to his present appointment.

Meader Appointed Advertising Manager for B-I-F

B-I-F Industries, Inc., Providence, R. I., has announced that Mr. Davol H. Meader has been appointed Advertising Manager to succeed Mr. H. D. S. Chafee. Formerly Assistant Export Sales Manager for Proportioneers, Inc., Division of B-I-F Industries, Mr. Meader received his education at Providence Classical High School, Phillips Andover Academy and Brown University. He is a member of the Foreign Trade Club of Providence and Delta Phi Fraternity.

ALCO Acquires Central Pipe

American Locomotive Company, Schenectady, N. Y., has announced the conclusion of negotiations for the acquisition of the business, plant, machinery, equipment and inventories of the Central Pipe Fabricating & Supply Company of Cincinnati, Ohio, from the joint owners—the H. K. Ferguson Company of Cleveland and the Associated Piping & Engineering Company of Compton, California.

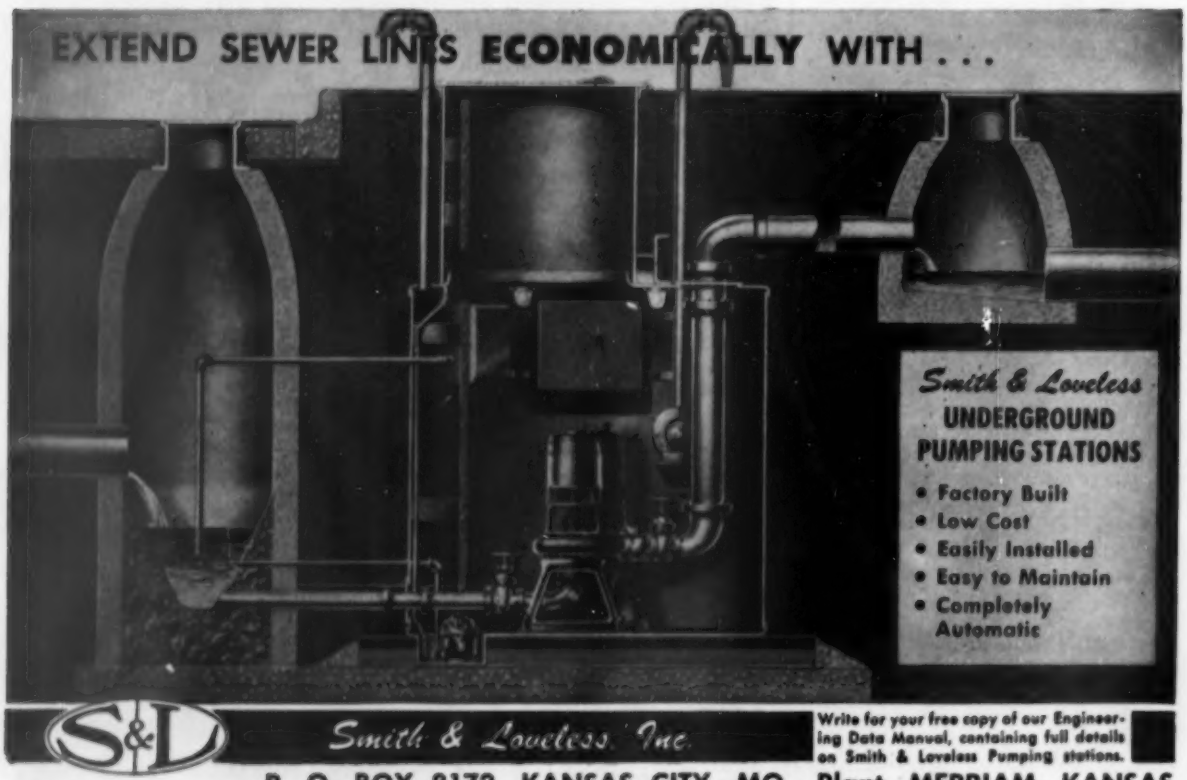
Perry T. Egbert, ALCO president, said that the acquisition was in line with the growth plans of the company, as ALCO now would be in a position to offer a full line of prefabricated pipe.

The new plant property consists of two buildings on 16½ acres of land in an expanding industrial area some 20 miles north of Cincinnati. The plant has a present capacity of approximately 200 tons of prefabricated process and power piping a month, ranging in size from 2½ inches up to 24 inches.

Cochrane Appoints Turbine Equipment

Cochrane Corporation, Philadelphia, Pa., has announced the appointment of Turbine Equipment Company, of Glen Falls 3, New York, as their representative for Upper Eastern New York State area.

Under this appointment, Turbine Equipment Company will handle water conditioning equipment, steam specialties and condensate booster and return systems manufactured by Cochrane Corporation.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P. O. BOX 8172, KANSAS CITY, MO., Plant, MERRIAM, KANSAS

Water Works Supply Co. Expands

Water Works Supply Co., Temple City, Calif., has announced that their new offices at 9602 E. Las Tunas Drive, will be in charge of M. R. "Hank" Bramman.

Water Works Supply Co. are agents for: S. Morgan Smith; Ross Valve Mfg. Co.; Multiflex Mfg. Co., and Leadite Company.

Johns-Manville Expands Pacific Coast Organization

Johns-Manville Corp., New York, N. Y., has announced the expansion of the company's Industrial Products Pacific Coast merchandising organization to further increase service to the company's Western customers.

Arthur W. Knight has been named Pacific Coast Merchandise Manager for the J-M Industrial Products Division and Johan H. Peterson will continue as Pacific Coast Staff Manager for Johns-Manville Transite, Asbestos-cement, pipe products.

Other appointments include the promotions of Lawrence M. Osborn to Pacific Coast Staff Manager for J-M Industrial Products (other than Transite pipe); and of H. C. Bruner to Pacific Coast Staff Engineer for the J-M Industrial Products Division.

Headquarters for J-M merchandising operations are in the company's San Francisco offices.

Harry Lundquist of Neptune Retires

Succeeded by Howard Lundquist and R. J. Wigley

Neptune Meter Co., New York, N. Y., has announced that Harry E. Lundquist, Minnesota and Dakotas representative of the company for the past 27 years, has been succeeded by his son, Howard H. Lundquist, and Robert J. Wigley. Neptune has a mandatory retirement policy at age 65.

Mr. Wigley after attending Mankato High School, studied at Mankato State Teachers College, and the University of Minnesota before completing service with the U. S. Army in Germany. Prior to his military service, Mr. Wigley was employed by the Continental Can Co. He will cover the states of North and South Dakota.

Howard Lundquist, who has been assigned to Minnesota, joined Neptune in 1950 in the Chicago office after four years experience as an inspector in a foundry and as an accountant in a paint factory.

125# Valves...drop tight!

Will not "freeze" from corrosion— *Corrosion can't hinder operation.* Disc edges are chrome plated or stainless steel and close into a thick rubber seat. These features plus self lubricated bearings and stainless steel shafting make it impossible for valves to "corrode tight" either open or shut.

Full 90° closure into Rubber Seat— The disc is slightly larger than the inside of the rubber seat and thus actually displaces the rubber when closed. The ratio of seat thickness to disc indentation insures drop-tight shut off and avoids permanent set. The seats are secured in the valve body by removable keeper segments.

Saves space. Even these high pressure valves are compact, easy to install, and require little head room. Available from 10" to 72" diameter in either cast iron or fabricated steel. A variety of operator types can be supplied.

WRITE FOR COMPLETE DETAILS:

"UNDERSTANDING THE BUTTERFLY VALVE" . . BULLETIN 2C
LOW PRESSURE VALVES . . BULLETIN 1C
HIGH PRESSURE VALVES . . BULLETIN 4C

HENRY PRATT

RUBBER SEAT
Butterfly Valves

Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

W&SW

New Literature

Tanks and Pressure Vessels

323

The Nooter Corporation, St. Louis, Mo., has just released a 48-page bulletin on Custom Fabricating **Tanks and Pressure Vessels.**

The work describes in words and pictures the facilities and workscope of this large midwestern fabricator—offering the latest techniques in the custom fabrication of steel and alloy plate.

Particularly useful for reference purposes are the comprehensive Corrosion Data Tables for various metals. They list the corrosive action of 200 different chemicals in various concentration forms on 16 different metals. These data have been developed in collaboration with research laboratories of the nation's largest metal producing companies.

Independence Hall in front of which old cast iron main still serves.

AMERICA'S OLDEST

CAST IRON WATER MAIN

TIED IN WITH NEW

The first cast iron water main in America was installed in Philadelphia in 1821. Last year this 133 year old 10" water main in front of historic Independence Hall was tied in with a modern new 16" feeder main because the venerable old main was found to be still in good condition.

This illustrates dramatically the permanence and long run economy of cast iron pipe—the best buy for cities anywhere.

Tie-in of old 10" and new 16" mains.

Our company does not manufacture pipe, but has long supplied the nation's leading Cast Iron Pipe Foundries with high grade foundry pig iron from which pipe is made.

WOODWARD IRON COMPANY

WOODWARD, ALABAMA

New "Plan-A-Lab" Folder

324

Metallab Equipment Corp., Hicksville, N. Y., has available a transparent plastic guide rule and template corresponding to the ¼" to 1 foot scale, with rectangular cutouts representing various base units in their new **Planning Kit** which will assist Laboratories, Research Departments, Hospital, Architects and Engineers in planning their modular layouts.

Illustrated on Page 2 is a compactly designed floor showing all types of bases that would layout properly. An Explanatory Chart is shown on Page 3, which states the types of units that are above and below the table tops.

The back page lists and illustrates service symbols and letters. In addition, Metallab's recommendations of Color Schemes, Floor Coverings, and Illumination are described. Specially designed graph paper is inserted. This paper is ¼" to 1 foot, to assist you in using the "Plan-A-Lab" folder.

Principles of Chlorine Gas Feeders

325

Builders-Providence, Inc., Providence, R. I., has reprinted a paper entitled **"Principles of Chlorine Gas Feeders"** as it appeared in *Water and Sewage Works Magazine*. Written by R. W. Pearce, Manager, Chlorinizer Sales, Builders-Providence, Inc., this 12-page reprint, in addition to basic Chlorine Feeder information, contains special reference to applications of chlorine in the treatment of industrial waste. Numerous photographs, diagrams, tables, and flow sheets clearly illustrate this important and informative article, which treats on such subjects as "Handling Chlorine," "Dissolving Chlorine," "Withdrawing Gas from Containers," "Types of Feeders," "How Feeders Operate," "Methods of Control," "Feeder Installation," "Treatment Processes," etc.

Grooved End Valves

326

The Lunkenheimer Co., Cincinnati, Ohio, has just released a comprehensive, completely illustrated four-page circular describing **Iron Body Bronze Mounted Grooved End Valves** for grooved end couplings.

Lunkenheimer Grooved End Valves, available in 2½ to 8-inch sizes in standard 200-Pound W.O.G. gate valve patterns and in a 2-inch size 225-Pound W.O.G. "King-clip" pattern, are designed to give valve users greater pipe line flexibility while reducing labor costs.

The circular also contains complete dimensions and price lists.

Automatic Proportional Operation of Chlorinizers

327

Builders-Providence, Inc., Providence, R. I., has issued a technical bulletin on flow responsive or **Automatic Proportional Pacing of Chlorine Feeders.**

Photographs and typical installation diagrams illustrate this bulletin, which describes several automatic pacing systems tailored to solve a variety of chlorine feeding problems. The systems described assure continuous, constant chlorine dosage regardless of variations in flow being treated. The flow responsive device, the converter, and chlorine feeder best suited to the applications are considered at length.

The Story Of Rubber Couplings

328

Hamilton Kent Manufacturing Co., Kent, Ohio, has published a brochure entitled **"Joint Enterprise"** that tells the story of the use of rubber as a coupling medium in clay and concrete pipelines.

The brochure describes how Tylox Rubber Joints form a compression seal in pipe joints and prohibit the infiltration of ground water and silt into the pipeline. A history of the use of rubber couplings in the past is given along with complete information on Tylox gaskets, such as: the development and manufacture of the gaskets; Tylox applications to pipe; and the use and performance of the gaskets. Several pages of actual installation photographs are given along with the case history of each installation.

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. . . give these outstanding plants—corrosion free construction • uniform flow distribution • low head loss.

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For details on monolithic and pre-cast Wheeler Bottoms, write Builders-Providence, Inc., 350 Harris Avenue, Providence 1, Rhode Island.

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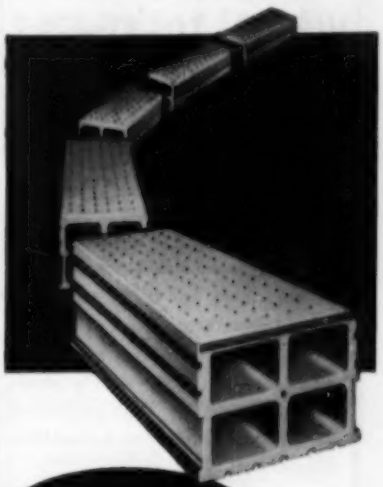

Leopold

Glazed Fire Clay Tile Filter Bottoms

During 1954 more Leopold duplex filter bottoms were sold than in any previous year in our history. To date, there are well over 300 plants (with a daily capacity in excess of 1¾ billion gallons) that have selected Leopold bottoms—including such major municipal installations as Phoenix, Arizona; Houston, Texas; Trenton, New Jersey; Detroit, Michigan; Baltimore, Maryland; Columbus, Ohio; Kansas City, Missouri; Omaha Nebraska; and Philadelphia, Pennsylvania. Represented in this group are the five largest municipal filter plants under construction in the country at this time.

There are, of course, good reasons why the Leopold Glazed Tile Filter Bottom is getting more popular every day. In this design, laterals and distributing blocks are combined in one permanent unit that insures equal distribution and uniform filtration. The individual blocks are made of de-aired fire clay, vitrified and salt glazed. They resist corrosion, are not subject to tuberculation, won't absorb any detrimental amount of water, are impervious to acids and alkalis, and will last indefinitely.

If you're looking for a practical, economical solution to your underdrain problems, consider the advantages offered by Leopold. We'll be glad to supply details—without obligation.

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Clean Waters Bulletin Available From G. E.

329

A new publication entitled **"Clean Waters—And How To Get It"** has been announced as available from the General Electric Company, Schenectady, N. Y.

The two-color, 34-page bulletin, is designed to help civic leaders, municipal officials, and sewage treatment experts dramatize to their communities the urgency of providing proper sewage treatment and how to get it.

It contains facts on water pollution, a four-step course of community action to fight pollution, examples of successful municipal campaigns, and methods of maintaining public support for such programs.

Index of Literature

330

Minneapolis-Honeywell Regulator Company, Industrial Division, Philadelphia, Pa., has released a **Classified Index of Literature** that lists all current Honeywell Industrial Division literature.

Numbers and titles of all Catalogs, Bulletins, Specification Sheets, and Instrumentation Data Sheets are included.

Fluoridators

331

Wallace & Tiernan, Newark, New Jersey, has available a folder that presents the company's complete line of **Fluoridators.**

Illustrated by large photographs, the folder discusses W&T: Solution Feed Fluoridators; Volumetric Fluoridators; Loss-of-weight Fluoridator; and the Merchen scale fluoridator. A business reply card is also enclosed in case additional information is desired.

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Product Data on Fluorides

332

Blockson Chemical Company, Joliet, Illinois, has available technical data bulletins on **Sodium Silicofluoride** and **Sodium Fluoride.**

These bulletins give, in addition to a general description of the fluorides the following information: Formula; Strength; Solubility; Properties; Principal uses; Grades; Packing; R. R. Classifications; and Special Conditions.

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Tide Gates

333

Brown & Brown, Incorporated, Lima, Ohio, has available a series of bulletins on **Tide Gates.**

Each bulletin is devoted to one particular type of gate, such as: Circular Tide Gates; Rectangular Tide Gates; Cushioned Tide Gates; Gate for Automatic Sewage Regulation; and Automatic Drainage Gates. In addition, other bulletins cover: Hydraulic Problems Involved in automatic sewage regulators; Loss of head through tide gates; Tide gates on short tubes; and two bulletins of actual installation photographs.

Cyanide Wastes Bulletin

334

Columbia-Southern Chemical Corporation, Pittsburgh, Pa., has just published a 16-page technical service bulletin on the use of **Chlorine and Hypochlorites For The Treatment of Cyanide Wastes.**

The use and advantages of chlorine compounds, methods of application, and details of operation and equipment are all covered. The bulletin also includes flow charts for various methods of treatment.

Coatings for Sewer Pipe

335

Inertol Co., Inc., Newark, N. J., has released a folder that discusses how **Inertol Protects Sewer Pipe.**

The folder describes how Inertol protects concrete and metal from destructive sewer gas, moisture, fumes, condensation and abrasion. Installation photographs and case histories are also included.

Page 4 contains the Inertol Quik Chek Paint Guide that shows the economical painting system for each waste tank, pipe and similar surface exposed to domestic or industrial sewage.

Check Valves For Water Hammer

336

The Williams Gauge Co., Inc., Pittsburgh, Pa., has just released a 4-page bulletin on the **Williams-Hager Flanged Silent Check Valves** for the control of water hammer.

In addition to technical descriptive data the bulletin includes a series of dimensional charts for valves of various sizes and pressure ratings.

CEMENT GUN CO. USES "GUNITE" FOR DISPOSAL PLANT REPAIRS

The top photo shows badly disintegrated concrete Imhoff Tank of a small New Jersey Sewage Disposal Plant. The repairs involved removal and rebuilding of two walls of this tank in their entirety, together with the relining of the tank with two inch "GUNITE."

The two trickling filters were also repaired with "GUNITE" to a thickness of two inches both inside and outside, as well as rebuilding sections of the circular wall. On the interior of the trickling filters the "GUNITE" was carried down eighteen inches below rock line.

The repairs illustrated above have restored the Plant at small expense to original design.

Many varied types of repair, remodeling and new construction with "GUNITE" are described and illustrated in our Bulletin C-3000. A request on your letterhead will bring a free copy by return mail.

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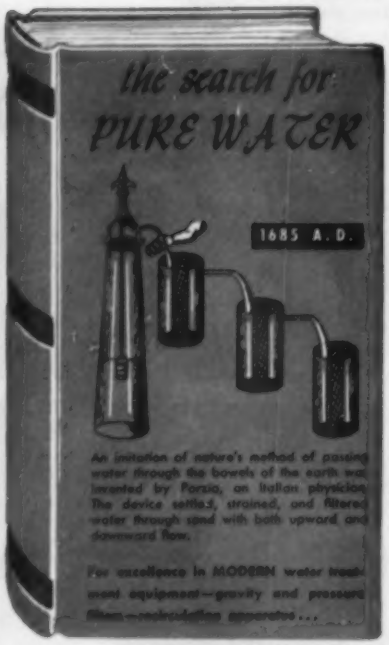

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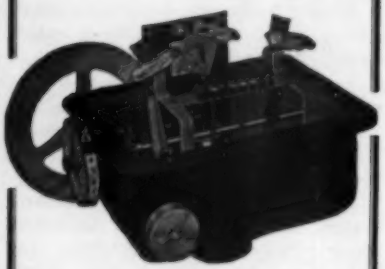

RF-2

WITH ALTO-TROL

This 2-pump RF-2 Roto-Trol assures equal use and wear of both pumps. Each pump is operated on alternate starting cycles. The RF-2 operates both pumps together, when required. RF-2 installations give dependable service year after year, with the minimum of attention.

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Pipe Cleaning Service

337

Flexible Pipe Cleaning Company, Los Nietos, Calif., has available a bulletin entitled **"Have Flexible Clean That Clogged Pipe."**

The bulletin, by means of a series of over 20 photographs with explanatory captions, shows the typical methods and equipment used by Flexible in a wide variety of pipe cleaning jobs. Also included are a list of municipalities and industrial concerns that Flexible has recently served. A chart of flow factors, a complete pipe cleaning record, and an estimate form complete the bulletin.

Cathodic Corrosion Control

338

Harco Corporation, Cathodic Protection Division, Cleveland, Ohio, has available a booklet on **Harco Cathodic Corrosion Control.**

By means of photographs, drawings and explanatory text the booklet covers in detail: the effect of corrosion; the cause of corrosion; the solution of the corrosion problem; and the economics of cathodic protection. Also included is a complete description of the company's warranty and service.

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For measuring turbidity of water. Consists of cast aluminum housing, adjustable lamp . . . two vertical wells for holding two Nessler tubes.

This apparatus comes ready to plug into 115 volt line, comes fully equipped for normal operation.

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General view of the plant — sedimentation basins in the foreground and Chemical Building at rear center.

Interior view of Chemical Building showing Omega Chemical Feeders and Lime Slakers. C. U. Pollard, Plant Supt., is checking plant operation at the centralized Control Panel at right.

Leon W. Jackson, Resident Engineer for Headman, Ferguson and Carollo, at filter table with Builders Loss-of-Head and Rate-of-Flow Gauges. The main instrument panel shown here and a second "repeater" panel in the Chemical Building meter all major plant functions by means of Builders Chronaflo and Pneumatic Instruments.

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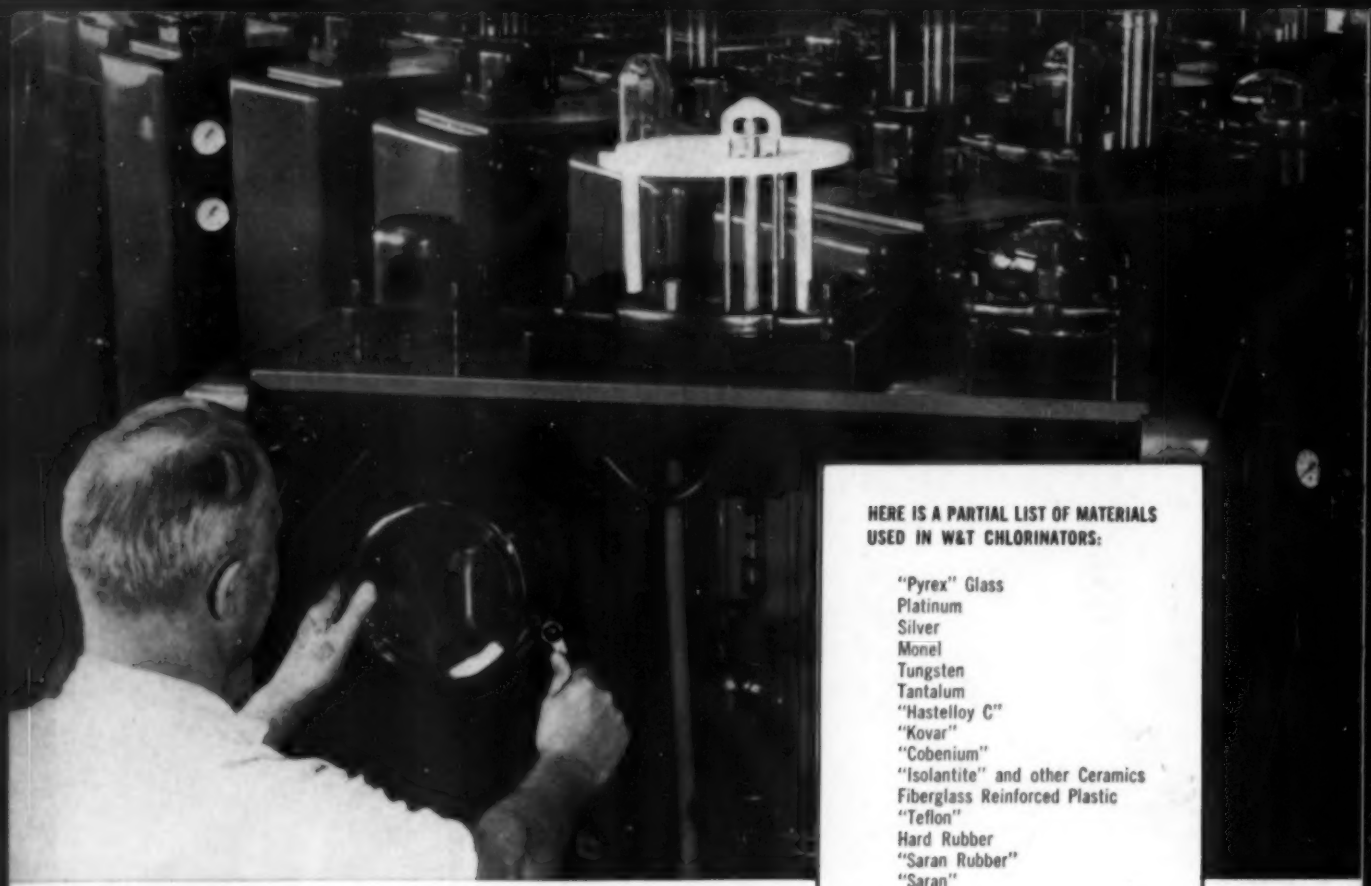

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